JOURNAL
OF
ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

VOL. 13 DECEMBER, 1920 No. 6

Proceedings of the Fifth Annual Meeting of the Pacific Slope Branch of the American Association of Economic Entomologists

The fifth annual meeting of the Pacific Slope Branch of the American Association of Economic Entomologists was held in Room 211, Science Hall, University of Washington, Seattle, Wash., June 17–18, 1920.

The first meeting was called to order at 9.30 o'clock a. m., June 17, by Prof. A. L. Melander at the request of Chairman E. M. Ehrhorn, who was unable to be present. Professor Melander was then elected chairman for the meetings and Dr. Edwin C. VanDyke as secretary in the absence of E. O. Essig.

A brief business session followed in the morning and in the afternoon and on the following day the regular papers were presented and discussed. Officers were elected on the last day of the session.

Although the number of members present was small there were many other interested entomologists present and the meetings were successful in every respect. The meetings afforded an opportunity to take up at first hand many of the very interesting problems of the great Northwest and will materially strengthen the Association there.

PART I. BUSINESS SESSION

The business meeting was called to order by Chairman A. L. Melander at 9.30 o'clock, June 17, 1920. The following were present:

*F. E. Bailey, Prosser, Wash.
Alfred C. Burrill, Forest Grove, Ore.
Joseph DaVise, Yakima, Wash.
*Chas. W. Hauck, Yakima, Wash.
*J. Frances Killeen, San Francisco, Cal.
Trevor Kincaid, Seattle, Wash.
F. H. Lathrop, Corvallis, Ore.
A. L. Melander, Pullman, Wash.
E. J. Newcomer, Yakima, Wash.
*Max M. Reeher, Forest Grove, Ore.
*G. P. Rixford, San Francisco, Cal.
*Chas. L. Robinson, Yakima, Wash.
L. P. Rockwood, Forest Grove, Ore.
Anthony Spuler, Pullman, Wash.
*E. P. VanDuzee, San Francisco, Cal.
Edwin C. VanDyke, Berkeley, Cal.
R. K. Vickery, Palo Alto, Cal.
W. D. Whitcomb, Yakima, Wash.
*E. G. Wood, Walla Walla, Wash.

* Visitors.

The following committees were then named by the chairman:

Editorial: Edwin C. VanDyke, Chairman, Anthony Spuler, R. K. Vickery.

Nominating: Edwin C. VanDyke, Chairman, Anthony Spuler, R. K. Vickery.

Membership: E. J. Newcomer, three years, Chairman.

The report of the secretary-treasurer was then presented and was duly audited.

REPORT OF THE SECRETARY-TREASURER

Financial Statement 1919–20

1919				
Feb.	24.	On hand		$24.60
June	30.	Express on proceedings	$ .62	
1920				
March	29.	Paid for stamped envelopes	1.14	
May	2.	Paid for stamped envelopes	2.15	
	15.	Paid Affiliation fee to Am. Assn. Adv. Science	5.00	
			$8.91	$24.60
June	7, 1920.	Amount on hand		$15.69
		Refund from Am. Assn. Econ. Ent. *due*		8.91

Afternoon Session, June 18, 1920

At the end of the regular meeting the following committees were called upon for reports:

Nominating Committee

The following were nominated for office during the ensuing year:

For Chairman, E. O. Essig, Berkeley, Cal.

For Secretary-Treasurer, A. L. Lovett, Corvallis, Ore.

These were duly voted upon and elected.

Membership Committee

The membership committee made a recommendation that the Membership Committee of the parent Association be requested to revise the list of Pacific Slope members in order to elevate deserving associate members to active standing. This recommendation was received by those present and the chairman, Mr. E. J. Newcomer, was asked to take the matter up directly with the proper parties in the East.

Editorial Committee

This committee reported a revision of the papers submitted with the recommendation that because of very special interests certain

papers be returned to the authors in order to reduce as far as possible the proceedings to those papers of real interest to all of the members of the Association. The Secretary was asked to return the papers thus set aside.

CHAIRMAN A. L. MELANDER: This concludes the convention. We stand adjourned to meet at San Francisco, Cal., next year.

Meeting adjourned.

E. C. VANDYKE, *Secretary pro tem.*

PART II. PAPERS AND DISCUSSIONS

Morning Session, June 17, 1920, 10.30 p. m.

CHAIRMAN A. L. MELANDER: The regular papers for presentation and discussion will now be taken up. The first on the program is on "The Winterkilling of Codling Moth Larvæ."

WINTERKILLING OF CODLING MOTH LARVÆ[1]

By E. J. NEWCOMER, *U. S. Bureau of Entomology, Yakima, Wash.*

It is a common experience in the spring to find "winter-killed" codling moth larvæ. The writer, however, does not remember seeing any figures on the percentage of mortality resulting from different degrees of cold. Accurate figures could be secured only under controlled temperature conditions, but an opportunity has occurred recently of obtaining some interesting figures of mortality resulting from natural conditions.

In Washington State, temperatures far below the normal were experienced during December, 1919, ranging in the Yakima and Walla Walla valleys from $-14°$ to $-36°$ F. At Yakima, on December 9 and 10, there was a snowstorm with some wind, almost of the character of a blizzard, the temperature for the two days ranging between 7° and 16° F. The storm cleared away on the 11th, the minimum temperature being 0°. For the succeeding four days, the temperatures were as follows:[2]

December	*12*	*13*	*14*	*15*
Maximum	1	1	4	12
Minimum	−22	−24	−18	−9

During this period there were from 4 to 18 inches of snow on the ground. After December 15, the weather warmed up gradually, and

[1] Presented with permission of the Secretary of Agriculture.

[2] Figures taken from Climatological Data, U. S. Weather Bureau.

for five or six days after the 20th, the temperature remained above freezing.

Examinations of larvæ were made during the period from December 23 to February 28. It was found that wherever the minimum temperature had been lower than $-25°$, all larvæ, with no protection other than bark or burlap bands, were killed. At the Bureau of Entomology Laboratory in Yakima, the minimum temperature was $-25°$, and several thousand larvæ wintering in pupation sticks all succumbed. In orchards within two or three miles of the laboratory, and on higher ground, where the minimum temperatures ranged from $-20°$ to $-25°$, 80–90 per cent of the larvæ were killed. On still higher ground, with minimum temperatures of $-15°$ to $-20°$, the mortality was approximately 70 per cent. Reports from the Wenatchee Valley, where the lowest temperature recorded was $-20°$, placed the mortality at from 75–80 per cent. There was no opportunity of examining larvæ in situations where the minimum temperature was higher than $-14°$. In all cases, these figures apply to the larvæ wintering above the snow line.

As the ground was frozen at the time of the earlier examinations, it was impossible to ascertain the condition of the large number of larvæ which winter under the surface of the soil. In February, however, examinations were made of the larvæ which spun their cocoons about the tree trunks an inch or two beneath the soil surface, where they were undoubtedly covered with snow during the cold weather. On February 28, a banded orchard was examined near Zillah, Wash., where the temperature had dropped to $-24°$, according to an unofficial record. The land was somewhat rolling, and it is probable that the drifting snow had accumulated in varying depths about different trees, as there was a marked variation in the condition of the larvæ found on the various trees. The mortality ranged from 100 per cent on some trees to as low as 66 per cent on others, with an average for 280 larvæ counted, of 76 per cent. One interesting fact noted was that frequently, on tearing away the burlap band, one or two live larvæ would be found in the midst of a number of dead ones. It seems impossible, in these cases, that the live larvæ had any more protection than the others. They must simply have had more vitality.

All these records were obtained in the arid section of Washington. It would be interesting to know whether temperatures such as were experienced in this section would produce a similar mortality in more humid regions, such as the coastal sections of Washington and Oregon, or parts of the eastern United States.

CHAIRMAN A. L. MELANDER: The next paper is entitled, "Winterkilling of the San José Scale."

WINTERKILLING OF THE SAN JOSÉ SCALE

By ANTHONY SPULER, *Washington State College*

Since early in the spring there has been considerable evidence to lead the fruit grower to believe that the San José Scale had been killed in large numbers during the past winter. The usual method of scraping the bark of badly infested trees with a knife showed that the insects were not juicy as commonly found at this time, but that they were dry and came off readily.

In order to determine to what extent the scale had been killed, a thorough examination of their overwintering condition was made. Early in March the district horticulture inspectors sent in infested branches from a number of orchards in each of the fruit-growing sections of the state. This was followed a little later by a personal investigation in the field in which all of the fruit-growing sections were visited. Samples were cut from healthy trees in a number of orchards within a district. Every effort was made to secure material that was typical for the various localities visited. The material secured in this way was carefully examined. Thousands of individual insects were dissected off under a binocular and their condition noted. It was possible in this way to learn the per cent of San José Scale still alive. Following are the results obtained:

Locality	Total Counted	Dead	Alive	Per cent Alive
Clarkston	10,144	9,595	549	5.4
Walla Walla	12,816	12,388	428	3.2
Prosser	2,545	2,545	0	0
Yakima	8,595	8,526	72	1.5
White Salmon	2,093	1,729	364	17.8
Wenatchee	5,409	5,309	100	1.8
Spokane	2,485	2,013	472	19.2

In contrast to the foregoing is the average per cent of winterkill of the San José Scale for the past ten years, not including the winter of 1919–20 for the following localities: Clarkston, 19 per cent; Walla Walla, 24 per cent; Yakima, 32 per cent and Wenatchee, 40 per cent.

The high percentage of winterkill of the scale might be explained in two ways. In the first place the winter started rather early. In October the temperature in the fruit-growing sections dropped as low as 12 to 14 degrees Fahrenheit. This was in all probability before the scale had gone into hibernation and before they were in a condition to

withstand the severe cold. In the second place the weather was unusually severe. Weather records for the past twenty years fail to show a similar occurrence. The minimum temperature records for the various sections are as follows: Clarkston, −26; Walla Walla, −36; Yakima, −24; Prosser, −30; Wenatchee, −16 and Spokane, −15.

CHAIRMAN A. L. MELANDER: Mr. R. K. Vickery will now give a paper, "Petroleum Insecticides."

PETROLEUM INSECTICIDES

By ROBERT K. VICKERY, *Assistant Entomologist, California Spray-Chemical Co.*

The government lately published a warning foretelling the rapid depletion of our petroleum resources. We are now using millions of gallons of oil to kill insects. A shortage will inevitably multiply the price many times and, if I may, I would like to discuss briefly the subject of petroleum insecticides and also incidentally record a few observations and experiments.

In the past it has been economical to use the petroleum products of commerce for insecticides. Efficient sprays were made from kerosene, crude oil, lubricants, and the by-product distillates. The everyday household and industrial demand for these oils made them available in every market. Certain products, suitable for insecticides, were relatively cheap. Today these oils are sometimes hard to obtain and the price has trebled within the last five years. The reason is not hard to find. The refiners now find it profitable to make cracked gasoline and lubricants out of these cheaper oils.

With such excellent insecticides at hand there has been little incentive to study the toxicology of petroleum to insects. For many years it was presumed that these oils suffocated the insects by mechanically closing the spiracles. Shafer and others have shown that petroleum is a true chemical poison. This is simply demonstrated by the rapid killing of an insect confined in an atmosphere saturated with the gases given off by kerosene. Shafer also showed that for all practical purposes it was impossible to smother an insect. With the idea of suffocation in mind it was easy to select an oil purely by the physical properties, specific gravity, viscosity, etc., used to distinguish oils industrially. Toxicology is fundamentally a chemical study and little is gained by testing the insecticidal values of different oils distinguished from one another by their physical properties. We must go deeper and study the oils as chemicals if we are to improve our present knowledge.

No one knows what compounds in petroleum are actually toxic to insects. Chemically, petroleum is a complex solution of hundreds of compounds, and oils from different fields are composed of different proportions and arrangements of these. The present knowledge of the chemistry of petroleum is very limited. Certain structural series have been identified, but practically no compounds have been isolated or synthesized. At one time I was able to get a pure sample of Pentane. It had the physical properties of gasoline and its vapor proved equally toxic to the silkworm.

There is good evidence to show that not all petroleum products are toxic to insects. Kerosene, particularly in California, sometimes fails unaccountably to kill scale insects. Freeborn and Atsatt report that oil refined for medicinal purposes is not toxic to mosquito larvæ. The writer once tried to use a residual oil in mosquito work that failed to control when applied to the water in the usual thin film. Combining 10 per cent of kerosene or crude distillate restored its toxic properties.

It is possible that research might reveal that certain compounds in petroleum are particularly valuable insecticides. Economic demand might make it profitable to prepare these synthetically. To carry out such an investigation a closer study should be made of the physiology of petroleum as an insect poison. Shafer has made some progress along this line, using chemical methods, and has offered the suggestion that insects are killed with petroleum by an upsetting of the balance between the oxidizing and reducing enzymes in the body fluid.

At one time I took up this problem using histologic methods. The larvæ of the silkworm and the California oak moth, *Phryganidia californica*, proved to be the most satisfactory material on account of the ease with which the different organs could be dissected out. Two series of slides were made of each of these two species. In one series the larvæ were all killed by being exposed to the vapors of gasoline. The other series was made as a control. Both series received identical treatment. Some larvæ were treated by the hot water killing method and others by a modified fluid of Carnoy. Some of the larvæ of both series were not dissected but, hardened, cleared and mounted in paraffine so that complete serial sections could be prepared of the entire insect. Other slides were made of the various organs. These slides were stained with iron hæmotoxylin and counterstained to bring out the different tissues. It was almost impossible to find any difference between the gasoline killed and control material. The only consistent difference was in the ductless glands, the œnocytes, which showed great activity in the gasoline killed insects. This activity was shown by large drops of fluid around the inner periphery of the cell. Glazer found that the œnocytes secrete an oxidizing enzyme. Located, as

they are, enmeshed in the tracheæ close to the spiracles, their function is no doubt respiratory. Moore has pointed out that the spiracles are the weakest link in the insect's armor against contact insecticide. He has also shown that the heavy vapors of petroleum and the other volatile contact insecticides are the most efficient. These heavy gases will condense on the walls of the tracheæ. There may be some relation between these various observations but more work must be carried out before conclusions can be drawn.

Moore's work on the physical properties of contact insecticides is a valuable contribution to our knowledge of petroleum insecticides. His definition of wetting and spreading will eliminate confusion.

A knowledge of the chemistry of petroleum may make it possible to find compounds fatal to insects and not injurious to plants. Unfortunately oils penetrate plant tissues about as easily as they penetrate into the insect. The history of petroleum sprays has been a development of methods to protect the plant from the injury caused by the commercial oils. The emulsion has made it possible to dilute the oil with water. The early mechanical mixtures gave trouble. The soap emulsions have proved satisfactory where soft water is available. The invention of the miscible oil has made it possible to commercialize the soap emulsion. Unfortunately the miscible oil formula is not adapted to the heavy oils. We have found in California that a natural crude oil of about 24° Bé is the most efficient spray to control diaspine scales. This oil, coming direct from the wells, contains volatile and heavy fractions. The heavy fractions are no doubt valuable in that they control the rate of evaporation of the lighter and more toxic fractions. A blend of distillate and lubricating oil gives the same result. The high price of cresol soap has made the cost of miscible oils rather high compared to the home-made emulsion, that is if the cost is compared on the basis of petroleum content. The latest improvement has been along the line of colloidal emulsions. These can be made with any oil and being chemically inert will mix with hard water, lime sulphur solution, arsenates, etc. By using a mixture of different colloids as an emulsifier good spread and penetration can be obtained.

These emulsions have all been developed with the idea of protecting the plant from oil injury. Professor George P. Gray made a fundamental advance when he discovered that the unsaturated petroleum compounds were, as a class, far more injurious to plants than the saturated series.

Modern synthetic chemistry is making available hundreds of thousands of compounds not only derived from petroleum but from other sources. Some of these are undoubtedly toxic to insects. The scarcity of petroleum with its resulting high cost may make it profitable to hunt

out these compounds. We are still a long way from the ideal contact insecticide. This should be an active insect poison and harmless to the most tender foliage. It should have good keeping qualities and be usable either as a liquid or as a dust.

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Chairman A. L. Melander: We shall now take the regular noon recess and adjourn to meet again at 2 o'clock p. m.

Meeting adjourned at 12 m.

Afternoon Session, June 17, 1920, 2 p. m.

Chairman A. L. Melander: A very interesting communication to Secretary E. O. Essig, sent to me, will, I am sure, prove of interest to all present and will be read by the Secretary:

Gainesville, Fla.,
May 31, 1920.

Mr. A. L. Melander,
Agricultural Experiment Station,
Pullman, Wash.

Dear Mr. Melander:

I have delayed in reply to your kind favor of April 30, written at the request of Secretary Essig of the Pacific Slope Branch of our Association, as I had hoped that circumstances would so shape themselves that I might be able to attend.

However, it is now certain that I cannot be in attendance at that time, hence will comply with your request by sending a short letter which, if thought suitable, can be read at the meeting. This letter I have addressed to Mr. E. O. Essig, as Secretary, and am enclosing it herewith. You can transmit it at your convenience.

Thanking you very much for your invitation, which I regret I am not able to accept, I beg to remain

Very truly yours,

WILMON NEWELL,
President.

May 31, 1920.

MR. E. O. ESSIG, SECRETARY,
Pacific Slope Branch,
American Association of Economic Entomologists,
Seattle, Wash.

Dear Sir:

The writer has delayed reply to Mr. Melander's letter of April 30 in the rather forlorn hope that circumstances would shape themselves so that he could attend the session of the Pacific Slope Branch of our Association. However, developments have been such that it will not be possible for me to be in attendance, and I take this method of extending my greetings to your members and wishing for you a most pleasant and profitable meeting.

It seems to me the time has arrived for the economic entomologists to be more aggressive and to place the value of their profession more prominently before the public. Within the past two years there have been rather numerous complaints to the effect that entomologists are not as well paid for their services as the value of their work seems to merit. This must be conceded, but at the same time it must also be conceded that the economic entomologist has not made his services indispensable in the way that members of many other professions have. When it is realized that the entomologist is as necessary to agricultural production as is the chemist or the implement manufacturer this state of affairs will be remedied.

The economic entomologist has his future and that of his profession in his own hands. If he shows that he is, collectively, able to inaugurate, execute and complete entomological projects of magnitude which either prevent enormous losses from injurious insects or make the recurrence of such losses impossible he will come to be considered as a necessity, rather than as a convenience.

With few exceptions entomologists have thus far confined their efforts to investigating the habits of insects and in devising or recommending palliative methods. By "palliative" methods we mean such measures as merely reduce the loss without eliminating it or preventing its recurrence. Spraying, using poisoned baits and employing cultural methods all fall within this category. The employment of insect parasites or fungous diseases for control of a pest may be considered in the same light: they may reduce the losses, but they do not remove the source of the loss.

The time has come when entomologists should make ready for really big undertakings, such as the eradication of injurious species or prevention of the establishment of injurious forms new to our country.

We have only to glance over past history to see the opportunities along this line which have presented themselves, only to be neglected. Take the case of the gypsy moth, for example. Twice in the history of this insect in America its eradication has been within reach at moderate cost and with a minimum of effort. The expenditures out of public funds in fighting this pest have, to the present time, aggregated

more than $17,000,000 and the losses due to its ravages have exceeded this figure many fold. Its eradication is yet possible for the methods being used to prevent its spread are really eradicative in nature and have only to be employed upon a sufficiently extensive scale, with sufficient speed, to annihilate this pest in our country.

In the southeastern United States the cattle tick has already been eradicated from approximately 460,000 square miles, an area equivalent to the combined territory embraced in the states of Kentucky, Virginia, Tennessee, North and South Carolina, Georgia, Alabama, Mississippi and Louisiana. The year 1924 will probably see its eradication completed. One is tempted to ask why this task, of tremendous economic moment to the South, was not taken up and executed by entomologists, instead of by veterinarians?

The Federal Horticultural Board is now engaged, in the states of Texas and Louisiana, in a hand-to-hand struggle with the pink bollworm. Already approximately $1,400,000 of federal funds have been expended on the work of eradication and it is still far from complete.

In Florida a plant disease, citrus canker, has been eradicated during the past five years, at a cost of $1,342,000. Large as this figure appears, its intelligent expenditure has nevertheless saved from destruction the citrus industry of Florida, which represents an investment of $175,000,000 and which brought to the growers the past season not less than $43,000,000. This was not an entomological project in any sense of the word, though it happens that the work was under the direction of one who is an entomologist rather than a pathologist. It is mentioned here as an illustration of what can be accomplished and as an example which should be duplicated in the entomological field with as little delay as possible.

There are today under way in the United States no less than six campaigns to eradicate plant diseases. The efforts of the Federal Horticultural Board to eradicate the pink bollworm, of Florida to eradicate the banana root-borer, and of Mississippi and Florida to eradicate the sweet potato weevil, seem to make up the sum total of efforts along this line in the entomological field.

Is it not time that we were "up and doing"?

Very sincerely yours,

Wilmon Newell,
President.

President A. L. Melander: The next paper by W. Dwight Pierce, on "Commercial Entomology and the Service It Can Render to Organized Agriculture," will be read by Secretary VanDyke.

COMMERCIAL ENTOMOLOGY AND THE SERVICE IT CAN RENDER TO ORGANIZED AGRICULTURE

By W. Dwight Pierce, *Managing Director, Biological Department, The Mineral, Metal and By-Products Co., Denver, Col.*

Commercial entomology is such a new phase of economic entomology that it behooves us to give considerable attention to its possibilities, its field, the type of service it can render, and the trend of the times which has made this new branch of our science possible. We are living in a period of seething change and readjustment! Effort is being cast into new channels. Old methods are being ruthlessly thrown aside.

Two conflicting elements are battling throughout the world: the one is the demand for greater and greater efficiency in production, the other is the demand for greater leisure and less expenditure of physical effort. These two demands can be harmonized by coöperation, but strife may cost the loss of both.

The minds of men are tending toward the aggrandizing thoughts of special interest—selfish, personal interest. Everywhere we see those with like interests banding themselves together in one or another form of organization, in order to protect their own interests, and to get for themselves as much of an advantage as they can obtain. Such a tendency, unrestrained by the recognition of the rights of others, is dangerous to our commonwealth.

But the tendency to organize is with us, and we ourselves contribute our part to it. We can get nowhere by bewailing prevailing tendency. The world moves on and crushes those who delay its progress. We must therefore look on these matters in a different light. If the tendency is world-wide, there must be a basic, underlying reason for it, and hence there must be an element of truth, right, or justice in it. Let us seek this kernel of good and hold it up before the world, and say: "This is what all these great world movements mean, so let us profit by this knowledge, and turn the path of movement so that civilization will be improved."

I can see both good and bad in the overwhelming desire of every special group to organize, and I believe that we entomologists must recognize these facts and adjust our efforts to the new trend of affairs. We are concerned today with agricultural organization. Surely it has many advantages, but it can likewise become a weapon of harm.

Recent Tendency in Agriculture

In the last decade we have seen the organization of the producers of agricultural products develop with increasing momentum, until now the producers of many of our most important crops, and of many crops formerly little used, are well and efficiently organized. Now if the purpose of these growers' associations is merely to gain a control of the price of the commodity and to maintain its prices at a high level, or is designed to enable the growers to gain preferential special class legislation, there is an element of grave danger in them. Let us hope that the time will never come when every group of individuals is centering its efforts around getting all of the special class legislation it can get, and forgetting all about the rights of the citizens at large. Then there would be an end to American patriotism.

Let us picture a model growers' association, with its purposes and ideals, and the service it can render America. It is to such an organi-

zation that we as entomologists can render service of a very noteworthy nature. This association is composed of American patriots who put America first, their own beloved state next, and harmonize their own personal welfare with the welfare of their fellow citizens. These patriots will stand up boldly for the suppression of special privilege to any class, whether it be capital, or labor, producer, or non-producer; and will stand out just as firmly against discrimination aimed at any class. By coöperation they will solve their labor problems; will improve the grades and marketing condition of their products; open up and improve their markets; obtain fair rates of transportation and storage; prepare such legislation as will establish honesty in the industry and insure producer, handler, and consumer a fair deal; will create a greater demand and more fields of usefulness for their product; and will engage experts to study the special problems of their crops.

In the old-style agriculture every producer was a unit by himself, and he had to deal with men of business acumen who were better organized than himself. Now, when he is properly organized he has business agents who attend to the packing, marketing, transporting and sale of his products, and he becomes a member of a group dealing in a business way with other organized groups of people.

We are still in the preliminary stages of organized agriculture. The cotton growers of the South, for instance, have just completed their business organization, but so far they have as objectives, principally, those problems which point to improvement of marketing conditions. Later we can expect them to expand their ideals, until they themselves will employ expert advice in solving some of the tremendous problems of production which face them. As an example of associations which recognize the importance of technical advice, we may quote the Hawaiian Sugar Planters' Association, which has a fully equipped experiment station, and sends high priced experts to all parts of the world in quest of information, or parasites, or improved varieties. Here on the Pacific Coast we probably have more organizations, and more efficient ones at that, than anywhere else in the world at present.

The very fact that growers are organizing is a recognition of the fact that there is a community of interests, although it does not mean that the growers recognize how extensive is their community of interests, nor how many people are involved in these interests. Let us take a lesson from the newly formed American Cotton Association. This association recognizes a community of interest between growers, ginners, oil mill men, spinners, bankers and merchants, and all of the many special interests which handle cotton, and its membership takes care of these various interests. Such a breadth of vision is refreshing, for it holds promise of a coöperative uplift movement for a vast section

of our nation. It means that everyone who derives his income directly or indirectly from the production of cotton is a potential contributing member of this association, and our vision shows us a time in the near future when this cotton empire will be pushing forward on a sound financial and economic wave of prosperity. At the same time we can see how such a powerful organization in the hands of men of narrow vision can merely become a weapon of offense and even danger.

My point is that the grower must recognize that there are those, who do not produce his crop, who have as vital an interest in it as himself, and he must, in justice to himself and the other fellow, harmonize his organization and its activities with the interests of other people.

Next, the growers must recognize the necessity of protection of crops from injury, and that this protection must extend beyond their own membership, to everyone who produces their special crop. Furthermore, it often happens that this protection must extend to other crops entirely, and joint action with other associations is called for.

The Need of Concert of Action against Pests

Pests are no respecters of person. They are individualists, working for private gain. They do not operate by coöperation, except in the case of the ants, and consequently in the absence of leadership, their attack is often unexpected, irregular, and baffling. When we fight insect pests and diseases as individuals, we pit guerrilla warfare against guerilla warfare, and we have nothing but a continuous series of reprisals. When we fight them through organization, we pit scientific, organized warfare against aimless banditry. The result is obviously victory, although the struggle may be long and arduous.

Insects and disease create economic waste. They live as parasites on the results of our labors. They reduce our profits, they increase our expenses, they make our labor more arduous. In the wake of a great insect scourge there lie devastated fields, ruined prospects, indebtedness, consternation of labor. Business houses which have loaned on these devastated crops become financially embarrassed, and often fail; mortgages pile up on the farm; and real estate values depreciate. The ignorant labor flee before the wrath of heaven, and a once prosperous section grovels and bemoans its fate. This is not an overdrawn picture. It has happened over and over again in this country. One insect pest alone, the cotton boll weevil, extracts an annual toll of hundreds of millions of dollars in potential crops, and has cost this country over a billion dollars. It alone has scattered panic and poverty, debt and fear.

There is but one way to meet a great insect pest, and that is by organized coöperative effort. Private action against pests is of little avail, for practically any insect or disease can bridge the gaps and

barriers that separate the fields of the careful man from the fields of the careless man, and the careful man must do his work all over. Too long have we contented ourselves with the opiate of satisfaction that we have done all that we could do when we have treated our own fields, and that what happened thereafter was an act of Providence and beyond our power.

No insect or disease is beyond the power of mankind to combat if we go at it scientifically and with perfect coöperation. In fact we must do so in the future, or yield superiority in agriculture to the hitherto wild parts of the world where pioneers with vision are beginning to break the ground for competitive agriculture.

Don't let that chimera of tremendous cost stand in the road of more efficient production. Whenever someone has suggested, in the past, a comprehensive fight against some pest, the scientific world has held up its hands in holy awe, and monotonously cried, "It can't be done, it can't be done!" Are we such grovelling simpletons that we are afraid to tackle our problems efficiently, because we are afraid to mention huge sums of money? Who is there, that has the temerity to suggest that we can successfully fight a pest robbing us of one hundred million dollars every year, by appropriating a paltry hundred thousand dollars? Why should we waste our money by throwing it in driblets at an all-consuming pest? Can a regiment hold back an advancing army?

Gentlemen, I will venture to say that the time is not far distant when organized agriculture will view its economic problems with broad vision and will fight all insects and disease from a business standpoint. The business man does not view huge figures with alarm, when the evidence, the plans and the expected results are placed before him in a businesslike manner. It is therefore the place of the entomologist of the future to secure his facts, and record them after the manner of business, and to plan to meet insect attack in an effective and comprehensive manner.

The Function of Government Contrasted with the Function of Commercial Enterprises

The American people, and even our own membership, have fallen into the error of thinking that all great insect investigations and enterprises are functions of government, and not of private initiative. This mistake has greatly retarded many phases of agricultural progress, because it has led the individual to think that the Government would do his work for him. It is the province of the Government to investigate great problems and to give advice to all citizens on matters of a technical nature, and demonstrate new methods. When the entire

nation or a large section is threatened by pests or disease it is the function of the Government to render adequate protection to those sections unaffected. It is because of such operations that many of us have come to expect the Government to take charge of all of our pest problems.

But we would not, any of us, want to see the Government take over our fields and houses and operate them. Inasmuch as we hold that the question of production is a private affair, so also, except in unusual cases, is the question of stimulating, increasing or protecting production, a private affair. We must consider that control of pests which are widespread is no longer a function of government, but a function of private enterprise, in which the Government may assume the rôle of friendly adviser. It is not the function of government to market our crops, but we organize our marketing associations and the Government supplies us often with expert advice.

There is a distinct difference between advising and administering on a project.

Organized Agriculture Needs Organized Assistance

The farmers and growers have organized for mutual benefit. They view their problems in common and find that they as a body will be greatly benefited by a concerted attack on some devastating pest. They need scientific assistance to actually conduct the work of control, and they accordingly go about it in a businesslike manner, and ask a recognized company of experts to estimate costs and outline the methods of operation. Then by mutual assessment the cost is prorated among those who will primarily benefit, and the contract is let.

To proceed in this manner would mean efficient and effective action, and I have no doubt that such procedure will be the dominant method within a very few years.

The Advent of Commercial Entomology and What It Offers

For several years we have witnessed the desertion of official positions by men entering the commercial field. Last year the movement became very pronounced, and now we find quite a number of men in the field of pure commercial and professional entomology.

Let us canvass the field of this new profession and see what it has to offer, and how it can be of special service to organized agriculture, as well as to the individual grower. The commercial entomologist is a business man with a technical training. He has his office, and his assistants, and keeps a well-arranged library, and a file of general information on insect pests. The client seeks him out and states his problem, just as he would to the engineer. The entomologist then

gives his advice for which he charges a fee, or he undertakes to make an examination or inspection for a definite fee. Upon completion of his inspection, the client may ask for advice as to the best method of procedure and the cost, and may then decide to let the contract to the entomologist to do the work. He will in the majority of cases conclude that the professional entomologist can secure the materials and administer them more efficiently and cheaply than he himself can do.

This, then, is a sketch of what the commercial entomologist can do for the individual client. When we come to consider the large scale operations for an organization of growers, a community, state or government, we then find it absolutely essential that a business organization plan and execute the entire job. What are these large scale operations? They may be drainage propositions against mosquitoes, or horseflies, or wireworms; they may be eradication projects against insect-harboring weeds; or great wholesale fumigation of all the trees in a community; the introduction of foreign parasites; the spraying of vegetation, or treatment of the soil; or they may contemplate a variety of activities, all aimed at a comprehensive large scale eradication or control of a pest.

The commercial entomologist will go still farther, and will develop new insecticides and new apparatus for applying the same, and will in everywise devote his attention to making entomological service efficient.

Service Is the Only Reason for the Existence of Entomology

We will grant that in the early days of entomology, it was only a hobby of a few men who liked to study insects. But when we get down to the bottom of things, in this age of efficiency, we must agree that the only valid reason for the existence of any profession is the service it can render humanity. We who have been in entomology a decade or more have been frequently challenged by outsiders to show of what value our science is to mankind. We have stayed by our science because we believe that it has a distinct and great service to render, although many of us have felt that we were falling far short of our potentiality. It is only as we look at the damage insects do, or the products they produce, and study the many economic aspects of the question that we can gain the proper conception of our own sphere of activity.

We can proudly hold up our heads and tell the world that the entomologists hold the keys to the doors which will close out the depredators and thieves of agriculture; that we are equipped to quench the losses annually experienced by our animals and our crops. We must

show the man who produces that we are as good business men as he, that we understand his problems, and that we can help him make more money.

CHAIRMAN A. L. MELANDER: At this time I shall present a paper entitled: "An Index Number for Rating Codling Moth Treatments."

AN INDEX NUMBER FOR RATING CODLING MOTH TREATMENTS

By A. L. MELANDER, *Pullman, Wash.*

Fruit growers and entomologists have long felt the need of more exact methods of comparing the results of spraying than laboriously to sort over thousands of apples at harvest time and announce results in percentage of worminess. To gain accuracy it has been the custom to give a uniform treatment to a block of many trees and then to obtain counts from the central trees of the block. Even so, the central trees do not always produce the same percentage of worminess, for no matter how large a tract is treated individual trees will vary in the codling moth population they support. When it comes to comparing the value of different brands of similar sprays all used stronger than the minimum lethal dosage, when comparisons are to be made of differing methods of applications, when comparisons are to be made under conditions of varying infestation, or with trees of various ages, or in widely separated localities, the method of mass spraying and subsequent examination of selected trees for worminess has proved laborious, costly, inadequate, crude, and even misleading.

The western fruit grower is much concerned with "stings" on his fruit,—not the curculio stings of the East, but the spots resulting from the nibblings of those codling worms that died on their way into the apple. Wormy apples are not to be sold, but under certain restrictions stung apples can go on the market as lower grade fruit. In as much as a wormy apple shows that the codling moth spray was in that instance ineffective, but a sting usually indicates that the spray accomplished its purpose, we have in the ratio of worms to stings a simple and ready index to judge the merits of the particular treatment. Relatively the more stings there are the better the treatment has proved. It is much easier to express and compare treatments in terms of such index numbers than to keep in mind a series of variable factors, like the previous history and present contamination of the trees, when interpreting results.

To illustrate, a few citations may be made from codling moth spraying data.

No.	Treatment	Total worms	Total stings	Per cent wormy	Ratio worms to stings
1.	None	1,502	79	85.9	18.1
2.	MgAs: 1/100, 1/100, 1/100, 1/100	202	464	16.8	.436
3.	ZnAs: 1/100, 1/100, 1/100, 1/100	70	227	6.5	.308
4.	CaAs: 1/100, 1/100, 1/100, 1/100	135	395	9.2	.292
5.	LdAs: 1/80, 1/80, 1/80, 1/80	448	1,950	12.2	.276
6.	LdAs: 1/20, 1/50, 1/80, 1/50	96	348	9.0	.276

The foregoing results were obtained last year on 25-year old Ben Davis trees at Spokane. Judged by the per cent of worminess the lead arsenate spray was inferior to calcium arsenate and zinc arsenite. The coefficient of effectiveness places the lead arsenate treatment first. Comparing examples 5 and 6 one draws the conclusion merely that more larvæ hatched on the trees of 5 in proportion to the number of apples, for the coefficient of effectiveness is exactly the same.

No.	Treatment	Wormy apples	Stung apples	Per cent wormy	Ratio wormy to stung
7.	LdAs: 1/100, 1/100, 1/100, 1/67, 1/50	53	51	1.51	1.04
8.	LdAs and caseinate, same strengths	80	61	1.24	1.31
9.	CaAs and caseinate, same strengths	104	17	1.6	6.12

Citations 7–9 are from Lovett's recent Bulletin 169. Commenting on his results he states "the variations in the percentage of worms in the different plots are so slight as to be within the scope of experimental error, and comparative results are practically nil." However, the index numbers show that the lead arsenate killed proportionally about three times as many worms as did the calcium arsenate. The information in this case is derived from the number of stung and of wormy apples, instead of the total number of stings and of worms. Though possibly less accurate such data may be similarly compared.

Leroy Childs recently presented some interesting figures from his tests of the spray-rod and spray-gun. From the criterion of final worminess his conclusion was that the gun gave best results.

No.	Treatment	Per cent stung	Per cent wormy	Ratio worms to stings
10.	Gun; counts up to 12-ft. level	1.79	.79	.44
11.	Rod; counts up to 12-ft. level	3.9	.97	.25
12.	Gun; counts 12-ft. to top of tree	2.7	3.2	1.18
13.	Rod; counts 12-ft. to top of tree	4.0	3.8	.95
14.	Dust	1.19	3.08	2.60
15.	Unsprayed checks	1.86	12.0	6.45

The coefficient, now obtained by dividing the percentage of worms by the percentage of stings, gives a different interpretation to these figures, and shows that the best results were obtained by the rod on those apples growing not higher than twelve feet from the ground.

No.	Treatment	Total worms	Total stings	Per cent wormy	Ratio worms to stings
16.	LdAs, 1/50; 5 applications, rod..	873	2,643	5.36	.33
17.	Same........................	667	1,954	17.15	.34
18.	Same, gun....................	915	1,726	4.42	.53

Illustrations 16–18 were taken from Mr. Newcomer's results in our last year's coöperative spraying experiments at Yakima. The trees of 16 and 17 were in the same plot, but those of number 17 were adjacent to the block of unsprayed checks; the others were removed by several rows of sprayed trees. Although receiving identical treatment the trees of example 17 showed over three times as many worms as those of 16, but the index number remains the same. In terms of worm-free fruit the gun-sprayed trees excel; the index number, however, shows again that comparative excellence is an illusion and resulted from fewer larvæ hatching on those trees.

These citations illustrate that the ratio of worms to stings affords a more dependable index of the value of codling moth treatment than the customary percentage of final worminess. How far its application will extend will probably be brought speedily to light by investigators stationed over the country. It is applicable for cover sprays and sprayings. The calyx spray must be measured otherwise, for a proper calyx spray leaves no calyx stings. As codling larvæ sometimes nibble here and there, the number of stings is not an absolute indication of the number of poisoned worms. The effect of repellent additions to the spray, or of thickened apple skin in causing the larva to spew out its nibblings, may interfere with the validity of the index number, and the range of such effects should be investigated.

Despite some shortcomings, the coefficient method affords a means for interpreting codling moth treatments from a new angle. No matter how many worms attack a tree, how abundant or shy the crop, whether one or one thousand trees are sprayed, where the trees are located, or how many apples are finally examined, the ratio of unpoisoned to poisoned worms should be an approximately constant guide for evaluating each treatment.

Chairman A. L. Melander: We shall now have the pleasure of an address by M. L. Dean, of the Washington State Department of Horticulture, relative to the work of pest control.

Mr. M. L. Dean defined the special duties of the state officials and stated that the help of all was needed to accomplish the desired results, promising in return complete coöperation.

He also showed some very fine specimens of the egg masses of the fruit tree leaf roller, *Archips argyrospila* Walk., on apple twigs taken from the Bitter Root Valley, Montana.

A full discussion followed.

CHAIRMAN A. L. MELANDER: The next paper is entitled "Symbiosis of Blastophaga and the Fig Family."

SYMBIOSIS OF BLASTOPHAGA AND THE FIG FAMILY

By G. P. RIXFORD, *United States Department of Agriculture*

The great fig family, Ficus of the order Moraceæ, is one of the largest of the vegetable world. Botanists have identified and described more than six hundred species. Most of them are tropical evergreens, frequently of gigantic size, often parasitic or epiphytic. Fraser, speaking of the Morton Bay figs of Australia, said, "I observed several species upwards of a hundred and fifty feet high, enclosing immense iron-bark trees, on which seeds of the fig trees had been originally deposited by birds. Here they had vegetated and thrown out their parasitical and rapacious roots, which, adhering close to the bark of the Iron-tree, had followed the stem downward to the earth, where, once arrived, their growth was astonishing. The roots increase rapidly in number, envelope the Iron-bark, and send out at the same time gigantic branches, so that it is not unusual to see the original tree, at the height of 70 or 80 feet, peeping through the fig as if it were a parasite on the real intruder." The writer has seen the same thing in the tropics of Central America, where the giant fig had strangled the host to death, after which the rapid decay in the moist tropics allowed the torrential rains to wash out the decaying wood through openings in the enveloping fig, until the final result was a giant cylinder, 6 to 8 feet in diameter and 75 to 100 feet in height and 6 inches thick, still vigorously flourishing. The natives called it Matar Palo (tree killer). Other notable forms are the Banian tree, *F. benghalensis*, which sends down aerial roots or branches into the soil where they take root and form new trunks. The Banyan, under which Alexander camped is said to have sheltered 7,000 men, now measures 2,000 feet in circumference and has 3,000 trunks. Another important member of the genus is *Ficus elastica*, a rubber tree. A popular climber in California is *F. repens*, used for covering brick and other walls. Another remarkable species, native of South Africa, produces its fruit under ground. It is thought by some authorities that each Ficus species has its own

parasitic chalcis. Of the Blastophaga more than one hundred and sixty species are known, all parasites on the fig.

The Cultivated Fig

With two or three exceptions all the edible figs belong to the *Ficus carica* species. The number of cultivated varieties probably exceeds one hundred and fifty. One prominent California horticulturist, Mr. J. Leroy Nickel, at one time had over one hundred and twenty-five varieties in cultivation. Of this large number, the Lob Ingir, Turkish name of the well-known Smyrna variety, is unique in requiring pollination to cause the fruit to mature. Linneus and other botanists as early as 1774 reached the conclusion that the caprifig is the male form and all the common varieties, including the Smyrna, the female forms of a diœcious species. The caprifigs are called male, because they contain male or staminate flowers; the common varieties and Smyrnas are females, because they contain only female or pistillate flowers. These fertile or female figs may be again divided into two classes, namely, the Smyrna fig, the flowers of which must be pollinated in order to mature fruit, and the other large class, frequently called the Adriatic class, the fruits of which reach maturity without pollination, but contain no fertile seeds. The latter race includes most of the varieties cultivated in all fig-growing countries.

The Smyrna Fig

The figs of the Smyrna variety never set fruit unless the flowers are pollinated, or, as the process of hanging caprifigs in the Smyrna trees is called, caprification. Therefore the culture of the Smyrna fig necessitates the simultaneous culture of caprifig trees, in which the fertilizing insect breeds.

The fig is not a fruit in the sense in which we regard the apple, peach, etc., but is what is known to botanists as a receptable, upon the inner surface of which are arranged hundreds of unisexual flowers. At the apex of the receptacle is an opening called the eye, or osteolum, which in the young fruit is closed by a number of scales or imbricated bracts. The blossoms are therefore effectually cut off from the outer world, and as the female flowers cannot be supplied with pollen by the wind and cannot pollinate themselves, dependence must be had on the fig insect (*Blastophaga psenes*).

Life of the Blastophaga

The male or caprifig tree has two well-defined crops and a third which is in doubt by some authorities. To these, for convenience, the Neapolitan names profichi (spring crop), mammoni (summer crop),

and mamme (winter crop) have been applied. The mamme crop forms in autumn on the wood of the current season and the Blastophaga from the preceding mammoni oviposits in them when they have reached the size of filberts. By December these mamme fruits are the size of small walnuts and change but little during the winter. The insect hibernates in them in the larval condition and will endure a temperature of 14° or 15° F. without injury. As the weather becomes warm in spring, the insects develop rapidly and are ready to issue in April, when the spring (profichi) crop on the same or other capri trees is in a receptive condition. This crop grows in clusters on the old wood at the extreme ends of the branches and, unlike the mamme, which is nearly spherical, is much larger and usually has a pronounced neck. It is produced in enormous numbers, many times greater than any other crop, a wise provision of nature, as it is the one which is most abundantly supplied with pollen and also the one which is exclusively used to pollinate the main Smyrna crop. The late summer crop of the capri tree, known as mammoni, unlike the others, pushes from the axles of the leaves on the new wood and matures from August to the middle of November. This crop serves to carry the Blastophaga through the late summer and fall months. The Blastophaga from these mammoni figs oviposit in the winter crop, and thus the cycle of the yearly life of the insect is completed.

The Smyrna Fig Dependence on the Insect

The Smyrna fig, by far the best variety in cultivation, is more exacting than the Adriatic class in the relation between climate and fruit production, as its crop of fruit is absolutely dependent on the fertilizing insect (*Blastophaga psenes*), and its culture on a commercial scale is therefore confined to regions where the winters are sufficiently mild to permit the mamme, or winter insect-bearing crop, to live through without injury. Experience shows that if the mamme crop is oviposited in, it will endure about the same temperature as the twigs of the tree to which they are attached. All caprifigs, if not oviposited in, dry up and fall off. The larva of the insect is just as essential to make the caprifigs hold on and mature, as is the pollen to make the Smyrna fig hold on and mature.

The parasitic insect of the *Ficus carica* species, *Blastophaga psenes*, lives but a short time after leaving the harboring receptacle. The female is shining black, has a good pair of wings, and is less than an eighth of an inch in length. The male is brownish yellow and is wingless. It is doubtful if the insects eat at all. In 24 hours after issuing from the caprifig, most of the females are dead, and in 48 hours all have succumbed. Most of the males die in the fig, though considerable numbers crawl out after the females have left.

Fig Pollination

In California the insect, which hibernates in the larval form during the previous few months, reaches maturity in April. The male leaves the gall first. He moves about the interior of the fig, and, finding a gall containing a female, gnaws a hole through the cortex of the ovary at the base of the style and fertilizes the female while she is still in the gall. The gravid female enlarges the opening and sometimes makes another, usually at the base of the style, probably because it is the point of least resistance. In from 22 to 48 hours she leaves the gall, reaching the open air through the cluster of male flowers, the anthers of which at this time have burst and are shedding large quantities of pollen. Her body is moist and sticky and she is frequently so loaded with pollen that she is unable to fly until she divests herself of much of it, in the same way that the common house-fly strokes its body with its legs.

After being relieved of part of the load, she flies to the nearest fig, and if it be in the right condition she immediately seeks the opening at the apex. At this time the figs are hard, and from a quarter to three-quarters of an inch in diameter, and the eye is closed by the overlapping scales. She pushes her head under the thin edges, and after a short struggle makes her way down to the interior of the fig, generally leaving her wings behind.

While one insect is probably sufficient to fertilize a fig, it is not unusual, where they are very abundant, to find a dozen or fifteen in one small fig, and as many more in a struggling mass trying to effect an entrance; often the cluster of wings can be seen radiating from the eye like the plumes of a miniature feather duster. If the caprifig from which the insect has issued has been hung in a Smyrna tree, she enters a Smyrna fig and then finds she has made a mistake, as the flowers are of such shape that she cannot oviposit in them, and after wandering about in a vain effort to dispose of her eggs, in this way doing her useful work of fertilizing the female flowers, in most cases she crawls out. When the weather is warm, say 90° to 100° F., the insects are very active and come out of the caprifig with a rush. The writer has seen forty issue in one minute. The issue takes place almost entirely in the forenoon, unless a cold windy morning is succeeded by a hot sun in the early afternoon, when a considerable number appear. The movement depends much upon the weather. During cool windy mornings very few issue, but if the next morning is warm, calm, and sunny, a great rush occurs. The insects continue to issue from a single fig for a week or ten days if the weather is favorable, and from the figs of various capri trees for two or three weeks.

The Symbiosis

The Symbiosis is one of the most interesting and of the greatest importance known. Walter T. Swingle, in an article in *Science*, says, "the Symbiosis is doubtless one of the oldest known, all of the hundreds of species of figs being inhabited by insects of a special family, Agaonidæ, which are all adapted to their peculiar habitat, while the figs appear as if specially constructed to nourish and protect the insects on which they are completely dependent for pollination." To show the intimate relation, or interdependence, of the insect and plant, it may be mentioned that the larva causes the mamme caprifig to hold on during the winter; furthermore, at the time the female has reached maturity and is ready to propagate the species, the anthers of the staminate flowers of the caprifig have burst, and are shedding quantities of pollen, and as if nature, seemingly to facilitate her exit, the bracts, which previously were flat over the eye, raise up and stand erect, permitting her easy passage. In some of the Ficus species, the male tunnels a passage for the escape of the female from the receptacle.

Smyrna Fig Growing a Promising Industry

The Smyrna fig industry is forging ahead in the great valley of California, and promises to soon become scarcely second to the raisin industry. Within five or six years, hundreds of carloads of dried Smyrna figs will leave the state to take the place of the fifteen or twenty million pounds annually imported from Asia Minor and other fig growing countries. And this great industry will be due to the minute, but beneficent, insect—*Blastophaga psenes.*

Chairman A. L. Melander: The Secretary will now also read a paper by Mr. G. F. Ferris.

INSECTS OF ECONOMIC IMPORTANCE IN THE CAPE REGION OF LOWER CALIFORNIA, MEXICO

By G. F. Ferris, *Stanford University, Cal.*

The Cape Region of Lower California

When the newspapers of the United States speak of Lower California they almost invariably mean nothing more than that portion of Lower California lying immediately south of the United States boundary. The part of the peninsula included in what is known politically as the Southern District is but seldom thought of.

To the extreme southern portion of the peninsula, terminating in Cape San Lucas, scientific writers have applied the term "Cape

Region." Geographically this area is quite sharply defined, coinciding in general with the Victoria Mountains and their foothills and definable practically as the area lying south of a line drawn from La Paz on the gulf coast to Todos Santos on the Pacific Ocean. The mountains rise abruptly to an altitude of as much as 7,000 or 8,000 feet and at the north descend into a low lying plain that at no point reaches an altitude of more than a few hundred feet. Two or three hundred miles of this plain intervene between the Victoria Mountains and the first range of any appreciable altitude to the northward. Owing to the presence of the mountains the rainfall of this area is much heavier than that of the plain and it is about the foot of the mountains that by far the greater part of the agriculture of the peninsula, except the region about Ensenada and the Imperial Valley in the extreme north, is carried on.

There has previously been no information available concerning the insects of economic importance occurring in this area. With the support of the California Academy of Sciences, the Department of Entomology of Stanford University and the United States Bureau of Entomology, the present writer spent some time during the summer of 1919 traveling in this region, and it is upon the observations made during this time that the following notes are based.

Characteristics of the Agriculture

The agriculture of the country is entirely in the hands of natives, there being but very few foreigners and these being engaged in mining or business. The agriculture as a whole is of an extremely sketchy sort. Such crops as demand attention are given such attention as they must have. Such things as will grow without attention are given every facility for doing so.

The principal crops are sugar cane, corn and beans. There is a certain amount of gardening and at San José del Cabo considerable quantities of sweet potatoes are raised. Also in some years tomatoes are raised at San José and shipped to the United States. A very small amount of tobacco is found but it is not produced in commercial quantities.

It is said that cotton was raised at San José del Cabo many years ago, and I saw a few feral plants at this place, but at only one locality, the Eureka ranch at La Rivera, is it now grown. At this point there were a few acres of none too prosperous plants.

The principal fruit is the mango. There are a few limes and not many oranges. Lemons were not seen at all. There are some guavas, avocados and bananas, but not many. Watermelons of a poor quality are plentiful. There are several native fruits that are eaten, but are

never cultivated, among these being the "pitahayas," the fruit of two species of cacti, which are held in high esteem. There are some cocoanuts, but the number is insignificant.

The streams which come down from the mountains in every case sink into the sand as soon as the lowlands are reached, to reappear at some point from a few hundred yards to a few miles from the ocean. It is in the valleys of these streams, before they sink into the sand and after they rise from it (principally the latter), that all the agriculture is carried on. Irrigation from the natural flow of the streams is depended upon, and in but few places is any attempt made to pump water.

Insects of Economic Importance

It is probable that the most important insect in this area is a chinch bug, *Blissus occiduus* Barber (det. Van Duzee), which infests the sugar cane and corn. At the time of my visit it was not especially abundant, but I was informed that at times it takes as much as 20 per cent of the crop. In fact the unusually high price of "panocha" (the crude sugar that is universally used) then prevailing was ascribed to the reduction in the crop caused by its depredations. This species was originally described from Colorado, but as far as I am aware has not been noted as a pest in the United States.

There is also on the corn and sugar cane a Tingid, determined by Mr. Carl J. Drake as *Leptodictya tabida* H. S., which is said materially to assist the chinch bug; and a Fulgorid, determined by Mr. Van Duzee as *Perigrinus maidis* (Ashmead), which apparently does no special damage.

A species of red spider was found in great abundance on beans at San Bartolo, but unfortunately the bottle containing the specimens was lost. At the time of my visit the bean crop had for the most part been harvested and I saw but one small field. In this the spider had killed practically all the plants and I was told that at times it causes a total loss.

In the field of cotton at the Eureka ranch some insect was working in the bolls. At the time of my visit it was too late to obtain specimens and only the work was found. Specimens of this work were forwarded to the Bureau of Entomology, and I am informed that it is a type of injury not before called to the attention of that office.

The nature of this work is as follows: The larva of the insect (one of which was seen) mines in the husk of the boll, sometimes but a single compartment being affected. Occasionally it breaks through the inner epidermis of the husks and feeds upon, or at least marks, the cotton, but in no case had it fed upon the seeds. Nevertheless the

seeds in the affected compartment fail to develop and the lint does not expand upon the opening of the boll, remaining matted and presenting a slightly smutty appearance.

Most of the cotton had been picked and it was impossible to get an estimate of the amount of damage caused by this insect, but it must have been appreciable, especially as the people were well aware of the damage.

Only a few plants of tobacco were seen, these being in a garden at Triunfo, and upon these a weevil, determined by Mr. H. S. Barber as *Trichobaris mucorea* Lec., was fairly common, although it apparently did no damage.

The citrus fruits are suprisingly free from pests, except for the red scale, *Chrysomphalus aurantii* (Maskell), which in some places is extremely bad. I saw also a small infestation of *Lepidosaphes gloveri* (Pack.), but beyond this no insects of any sort were seen on these hosts.

The mango, which in other parts of the world is host to numerous insects is here for all practical purposes free from pests. Aside from a few specimens of *Aspidiotus lataniae* Sign., and an apparently native species of *Asterolecanium*, no scale insects were found upon it. A few specimens of a Thysanopteron, determined by Mr. A. C. Morgan as *Heliothrips haemorrhoidalis* (Bouché), which causes a silvering of the fruit and leaves, were taken from it at San José del Cabo.

There are a number of scale insects on cultivated hosts, few of these of any importance. The black scale, *Saissetia oleæ* (Bern.) was seen, but was taken only from wild hosts and then in no numbers. What is probably *Pseudococcus citri* (Risso) (the specimens were lost) was seen on the fruit of mango at La Paz. *Asterolecanium pustulans* (Ckll.) is common on oleander. *Aspidiotus diffinis* Newstead was taken from guava at La Paz. *Pseudoparlatoria parlatorioides* (Comst.) was found in abundance on guava at San José del Cabo, avocado at Todos Santos and ornamental at La Paz. *Pseudococcus maritimus* (Ehrh.) was taken from a wild host at Cabo san Lucas but was not seen on cultivated hosts. An undetermined species of *Icerya* which I regard as *I. rileyi* Ckll., was found at San José del Cabo on numerous hosts.

An aphid, determined by Mr. A. C. Baker as *Aphis illinoisensis* Shimer, was found on grape at Triunfo but was not abundant.

A Tingid, determined by Mr. Carl J. Drake as *Corythuca gossypii* (Fabr.), was found in some numbers on castor bean at San José del Cabo. I was informed that the tomatoes here are at times lost by the ravages of what is apparently a Sphinx larva. A weevil has been taken from sweet potatoes at the same place but I saw no specimens.

I saw no evidence whatsoever of the existence of any kind of fruit flies within this area. Neither were any Aleyrodids seen on cultivated hosts.

Malaria carrying mosquitoes are present as I can testify from personal experience. I contracted a case of malaria that was diagnosed by a physician on my return to the United States as the tertian form.

The number of insect pests observed is surprisingly small. It is true that the observation of economic insects was but a part of the purpose of the expedition, but I am convinced that enough work was done to reveal all the forms of major importance. The reason is undoubtedly to be found in the isolation of the country and the small amount of traffic between this and other countries in agricultural and horticultural products. As confirmation of this I may note that although the primary purpose of the expedition was to search for scale insects I found but twelve presumably introduced species out of seventy-eight taken, whereas probably nearly half of the species of scale insects known in the United States are introduced.

It should be noted, however, that the time of my visit (July to August) was by no means the most favorable for making obervations in regard to insects, as this is the dry season. Also I may note that in September of the preceding year the country had been swept by one of the most terrific storms "within the memory of the oldest inhabitant." The effects of this storm were still felt and conditions were obviously abnormal. For instance, I was informed that the leaves had been absolutely stripped from the orange trees and that the infestation of red scale had thereby been much reduced. Doubtless the same reduction had taken place in the case of other insects also.

It may be well to call attention to the fact that although this region lies technically within the tropics its fauna bears a very close relation to that of southwestern United States. It is to be expected that any insect which will thrive in the latter area will thrive likewise in the Cape Region of Lower California.

Chairman A. L. Melander: The next paper "The Fitness of the Waters of the Santa Clara Valley for the Making of Spray Solutions," by Mr. E. R. DeOng, will be read by the Secretary.

(Withdrawn for publication elsewhere.)

Chairman A. L. Melander: I have been requested to read the next paper prepared by Mr. A. C. Maxson.

COMBATING THE SUGAR BEET WEBWORM ON A LARGE SCALE

By ASA C. MAXSON, *In Charge of Insect Investigations for the Great Western Sugar Co., Longmont, Colo.*

During the growing season of 1919 an outbreak of the sugar beet webworm (*Loxostege sticticalis* L.) occurred in the Rocky Mountain and intermountain states, which, when measured in terms of acres covered and damage wrought far exceeded any previous outbreak of this pest.

In those portions of Colorado, Nebraska, Wyoming, Montana and South Dakota which furnish beets for the Great Western Sugar Co., the first (June) brood of webworms covered 172,728 acres of sugar beets and the second (July-August) brood, 7,567 acres.

The extent of this outbreak, which covered a total of 180,295 acres, afforded excellent opportunity to test the possibilities of coöperation between large manufacturing concerns and the people furnishing the raw material. The object of this paper is to outline the methods used by the Great Western Sugar Company in handling a campaign which covered a portion of four states.

Early in the spring of 1919 preparations were begun to combat the webworms should they appear. These preparations were based upon the outbreak of 1918 which was the largest ever experienced up to that time.

Inability to foresee that the outbreak of 1919 was going to cover an area five times that covered in 1918 was the cause of inadequate preparations. This added much to the difficulty and expense of fighting the worms in 1919 since many sprayers and much insecticide had to be purchased after the campaign was on.

ORGANIZATION. The entire campaign was directed by the general agriculturist of the Sugar Company. In carrying out the work the following departments and employees of the Sugar Company organization were called upon:

THE PURCHASING DEPARTMENT. This department located and purchased all supplies of insecticide, spray machines and repair parts for the latter, and supervised their distribution and shipping.

SUGAR COMPANY ENTOMOLOGIST. The repairing and general overhauling of all old spray machines and the setting up and testing new machines was under the supervision of the Sugar Company entomologist. General instructions were issued by him to the local management in the various factory territories regarding the time of spraying and quantity of insecticide to use.

The entomologist was assisted by several men who were detailed

as inspectors. These men personally inspected and tested each spray machine in their territory and reported its condition to the entomologist.

Local Mechanical Department. Under the direction of the entomologist the local mechanical department of each factory repaired all old sprayers and set up all new ones.

Local Field Force. The local field force at each factory consists of an agricultural superintendent and several field superintendents or field men. The local agricultural superintendent supervised the work in his territory. In doing this he followed the general instructions given by the general agriculturist and entomologist, using his own judgment in adapting these to his local conditions.

Working under the agricultural superintendent the field men located infested fields and routed the spray machines in that part of the local territory under their charge.

Repairing Farmer Owned Sprayers. During the early spring each field man was required to report the number of spray machines owned by farmers in his territory and their condition.

A list of the needed repairs and repair parts was secured and the Sugar Company assisted the owners in securing these parts. Where the farmer so desired, machines were repaired by Sugar Company mechanics. In such cases the farmer was charged the actual cost of labor and material.

Testing Spray Machines. After the local mechanics had overhauled and repaired all old machines and set up all new ones each machine was tested by one of the inspectors mentioned above.

Owing to there being several makes of spray machines employed and several types and sizes of nozzles used it was necessary to learn just how much spray material was applied per acre by each machine in order to properly mix the insecticide. This was determined by hauling the spray machines along a road or field border until a measured amount of water was discharged through the nozzles. The distance traveled multiplied by the number of rows sprayed furnished the basis for computing the rate of application. In mixing the insecticide the quantity to be used per acre was mixed with the quantity of water applied per acre by the machine. All machines were tested out at 80 pounds pressure.

Field Operations. Several methods were employed in handling local operations. The most successful are outlined below:

Method No. 1. In the territories using this method a man who had assisted in overhauling and setting up machines was detailed as assistant to each field man.

This trouble man, as he was called, was furnished with a Ford auto

and trailer. The trailer was used to transport the sprayers from field to field. This saved much time and wear on the sprayers and insured their delivery at the desired field in good repair.

When not moving machines, the trouble man made the rounds of the machines operating in his territory for the purpose of repairing and otherwise assisting in keeping the machines in operation.

The field man being relieved of the necessity of attending to these details could put in his time locating infested fields. The field man was constantly in touch with the trouble man, directing the movement of the machines from field to field.

Method No. 2. This method required more men than Method No. 1, since a Sugar Company man was with each company owned sprayer in the field. This man kept the machine in running condition and assisted in preparing the poison and filling the sprayer tank.

The one drawback of this method is the danger of the company man becoming poisoned, locally, by constant association with the insecticide.

The field man's part of the work was the same as that in Method No. 1. The machines were hauled from field to field by the farmers, the next farmer in line arriving in the field an hour or so before he was to receive the machine for the purpose of learning as much about its operation as possible.

The relative effectiveness of these methods was practically the same.

A small per acre rental was charged for the use of the sprayer. This was usually 50 cents per acre, this amount being just about enough to pay for the repairs and labor of overhauling and the trouble man.

In the case of Method No. 2 this rental was made large enough to cover the wages of the special man with each machine.

The insecticide was purchased by the Sugar Company, delivered to the growers at cost and charged to their account to be deducted from their pay for beets delivered.

Work Accomplished. As has already been stated, the preparations made to combat the webworm in 1919 were based upon the outbreak of 1918 and were altogether inadequate. As soon as the extent of the 1919 outbreak could be anticipated additional equipment was procured. The unusual demand for insecticides and sprayers made the procuring of the additional supplies slow and costly. At the close of the season the Sugar Company had 303 traction sprayers while the farmers in the Great Western territories owned 471. Many of these were not secured before the season was well advanced so that the acreage covered was not as large as it would have been had the sprayers been on hand at the beginning of the season.

Owing to the difference in the equipment of the machines and other factors which had a marked influence upon the work done by the individual machines, it was necessary to express this in nozzle acres per calendar day in order to get an adequate idea of the work done.

The term nozzle acre per day indicates the number of acres sprayed by one nozzle in one calendar day based on the number of days in the spraying season.

The average nozzle acres per day for all company owned machines was 1.41. At this rate a 12-nozzle machine would cover 16.92 acres per day. During the height of the season such machines covered from 30 acres for 10-hour day to 90 acres per calendar day. Many machines were operated all night. Headlights were placed on them which were run by storage batteries from automobiles.

Sixty-one per cent of the entire 180,295 infested acres were sprayed with company owned sprayers. The Sugar Company purchased nearly a million and a quarter pounds of insecticide during the season.

The results of this attempt at controlling a sugar beet pest through coöperation of the Sugar Company and the beet growers were so successful that in spite of the probable reduction in the number of worms attacking the beets this (1920) season more sprayers are being purchased and several new forms of insecticide are being secured for experimental purposes.

During the season of 1919 Paris green, arsenate of lead, calcium arsenite and several other forms of insecticide were used. The Paris green gave by far the quickest and best results. This was used at the rate of 3.5 to 4 pounds per acre. This appears unusually heavy until we consider the great leaf area of an acre of beets and the need of quick results. Including cost of Paris green, labor and sprayer rental, the cost per acre was about $3.50. A timely and successful application of insecticide would mean, on the average, not less than two tons more of beets per acre. This at $10 per ton, the price paid in 1919, is $20 per acre or a profit of over 400 per cent on the investment.

CHAIRMAN A. L. MELANDER: The paper entitled "Results of Washing Experiments for Control of the European Elm Scale" will be read by the Secretary.

RESULTS OF WASHING EXPERIMENTS FOR CONTROL OF THE EUROPEAN ELM SCALE

By FRANK B. HERBERT, *Forest Insect Laboratory, Los Gatos, Cal.*[1]

A solid stream of water has been recognized for some time as being of some value in the control of certain soft bodied insects. It has been

[1]Forest insect investigations, U. S. Bureau of Entomology.

mentioned a number of times in its relation to the control of the European elm scale, *Gossyparia spuria* (Modeer).

In 1907, Prof. S. B. Doten carried on a number of experiments with water and obtained satisfactory results in controlling this scale insect upon elm trees in Nevada. In fact he obtained better results than when he sprayed with lime-sulphur or kerosene emulsion. These experiments are listed in Nevada Bulletin No. 65, "The European Elm Scale."

In 1917, it became apparent to Mr. Burke and the writer that the elms at San José, Cal., were suffering considerably from a heavy infestation by this insect. Some of the trees on the State Normal School grounds were well infested. The attention of the head gardener, Mr. Hollingsworth, was called to this fact, whereupon it was decided that control measures should be instituted. The use of water was recommended, with the approval of Mr. Doten and the County Horticultural Commissioner, Mr. L. R. Cody.

It was recommended that this be done in the spring after the females had become quite large, due to being full of eggs, and yet before many of the new elm leaves had unfolded to obstruct the force of water. There is but a short period when these conditions prevail. One gets some warning as to the time to do this by watching the fruit of the elm. The fruit matures and starts to fall a few days before the leaves unfold. This is the best time to do the washing, yet it may be done at any time until the females begin to lay eggs, which is seldom earlier than the last of May. However, some of the force of the water is dissipated when it hits the foliage and consequently the results are not as satisfactory. In 1918, the proper time to do the washing at San José was April 17 to 25.

In preliminary experiments, different sorts of nozzles were tried out upon the garden hose, using the water from the one-inch hydrants upon the Normal School grounds. The maximum pressure available through these pipes was 50 pounds to the square inch at the pump and probably quite a bit less by the time it had reached the nozzle. The best nozzle that could be obtained for this pressure had a rather long taper with an outlet $\frac{3}{16}$ of an inch in diameter. It threw a solid stream and was found to be effective upon the scale insects up to a distance of 12 feet.

On Small Trees

This was used a number of times by the writer and Mr. H. E. Burke in 1918 and 1919 to very good advantage to wash the mature scale insects from young 8- or 10-foot elms. All the limbs were within easy reach and the trees were so small that a thorough washing was possible.

The trunk and each branch and twig were hit with a solid stream of water, most of them receiving it from three directions.

The results obtained were highly satisfactory and these trees remained clean until early fall when young scales from nearby trees crawled onto them to hibernate. Some of the gardeners tried this out upon a number of young elms, but their results were less satisfactory apparently because they were willing to simply wet the trees instead of seeing that a forceful stream hit every branch and crevice from several directions.

On Medium-Sized Trees

It was found by using a 12-foot platform and a 7- or 8-foot extension rod that trees between 35 and 40 feet high could be reached, but since most of the trees had attained a height of 60 to 90 feet, the idea of using this was abandoned. However, one 40-foot tree was washed in this way on April 26, 1918, and was found to be only moderately successful. It proved to be quite tedious work, 1 hour and 40 minutes being required to carefully cover the tree. One year later the tree was apparently infested as badly as ever.

On Large Trees

The next problem which arose was how to obtain a greater pressure and volume of water so as to reach the tops of the larger trees. This was finally settled by the city of San José offering the use of water from their large mains and the loan of a steam fire engine. With the use of these the question of pressure and volume of water was completely solved.

Aside from the engine, the apparatus consisted of 1,000 feet of $2\frac{1}{2}$-inch hose, a short tapered nozzle with a circular $\frac{7}{8}$-inch opening, and a stand E to facilitate holding the nozzle. In spite of its name, this is a T-shaped iron bar, the lower end of which is pointed to stick in the ground. The hose is strapped to the upright piece, while the crossbar serves as a handle to be used in directing the stream. This is a very necessary part of the equipment and probably without it the crew would have refused to hold the nozzle for several days in succession. As the engine stood for a long time in one place no method of propulsion was furnished with it, but it was hooked to the rear of the gardener's one-horse wagon when moving was necessary.

At first, a pressure of 100 to 120 pounds to the square inch was maintained and later increased to 160 pounds. This threw a strong stream well above the treetops without doing any harm. In fact it was beneficial, giving the trees a good cleaning by removing all of the dead twigs and branches, besides incidentally giving the trees and

lawns a good irrigating. Even those leaves which had already unfolded were not torn a particle. It was reported that the capacity of this outfit was over 200 gallons per minute.

The crew consisted of one foreman to direct the work, one engineer to run and fire the engine and three hosemen to manipulate the heavy hose and nozzle. The wind caused some trouble by blowing the water back onto the hosemen, but this would have been of little importance had they been dressed in the proper clothes and had not been afraid of the water.

With this apparatus and crew, 191 large trees were washed in six days. This is an average of 15 minutes to the tree. Each tree was thoroughly and systematically covered in this time from at least two sides, each limb being followed out to its tip. This magnificent head of water covered an area a foot and a half square, approximately, by the time it hit the tree. It seemed as though no sort of an insect could be still clinging to a single limb which had been hit by such a deluge. In fact, very few did remain on the trees and these few were well protected by rough bark, a crotch of a limb or some such obstruction.

The cost at that time was as follows:

1 engineer, 6 days at $6.00	$36.00
3 hosemen, 6 days at $3.50	63.00
2¾ tons coal at $13.35	36.71
Actual cost	$135.71 = $.71 per tree

To this should be added the wages of a foreman and the cost of the water. These were both donated in this case but could not be counted on under ordinary circumstances. As this was an experiment, Mr. Hartman, of the Bureau of Entomology, acted as foreman to see that nothing was slighted. The water was very graciously donated by the city. Therefore to obtain the cost of the operation under the usual circumstances, the following figures should be added to the above:

1 foreman, 6 days at $5.00	$30.00	
500,000 gallons water at 12 cents + per M. (sliding scale.)	63.60	
	$93.60	$93.60
		$135.71
Total		$229.31

This gives an average actual cost of 71 cents per tree or a computed cost of $1.20 per tree, when adding the cost of water and a foreman. This does not include wear or rental of the machinery. One hoseman might be dispensed with, provided the foreman helped move the hose when needed, thus lowering the cost by about 11 cents per tree.

During all the following summer the trees remained quite clean, one or two showing evidence of a few scale insects by a slight drip. The writer estimated that about 85 per cent of the scales had been removed. However, one year later the trees were infested almost as badly as before the washing. Part of the reinfestation was due probably to the migration of young insects from all the surrounding well infested trees and partly from the estimated 15 per cent of insects left on the trees after the washing.

Conclusions

From these experiments the writer has concluded that the European elm scale on small trees can be treated very satisfactorily with the garden hose and nozzle and an average force of water. This is slower than spraying but is often easier than going to the trouble of obtaining the necessary apparatus for spraying where only a few trees are to be treated.

With larger trees it is necessary to obtain a larger volume of water at a higher pressure in order to produce satisfactory results. This can be obtained by using a fire engine, but is recommended only when a large capacity power spraying outfit is not available. The former is cheaper but somewhat less effective.

The ordinary orchard spray outfit is satisfactory for trees up to 35 or 40 feet high, but larger shade tree sprayers are made which will reach 90 feet high or more. Trees 60 or more feet high would require 30 to 40 gallons or perhaps more of spray material if properly covered, which would cost probably 5 cents per gallon by the time it was applied. Therefore the cost of spraying would be 25 to 50 per cent higher, but would probably be more satisfactory under the proper conditions.

Chairman A. L. Melander: The meeting will now adjourn to meet at the same place tomorrow morning. Adjourned.

Morning Session, Friday, June 18, 1920

Chairman A. L. Melander: The first paper will be read by the Secretary, entitled "The Spread of the Argentine Ant in Southern California," by R. S. Woglum and A. D. Borden.

(Withdrawn for publication elsewhere)

Chairman A. L. Melander: The next paper on the program is "Migratory Instincts of the Blue Bottle Maggots, *Phormia regina*," by A. C. Burrill and H. L. Jones and will be read by the senior author, Mr. Burrill.

(Withdrawn for publication elsewhere)

CHAIRMAN A. L. MELANDER: Mr. R. S. Woglum and M. B. Rounds have sent in a paper which will be read by the Secretary.

DAYLIGHT ORCHARD FUMIGATION

By R. S. WOGLUM and M. B. ROUNDS, *U. S. Bureau of Entomology*

Orchard fumigation of citrus trees in this country has, with few exceptions, been confined strictly to night operations from the earliest days of its commercial adoption. During hot weather trees have not been covered until sundown, but with the advent of cool weather in late autumn, fumigation was frequently started while the sun was still up; and in winter full exposure to gas was sometimes made on cool days. Occasionally a venturesome fumigator attempted daylight work in the winter without regard to temperature and, although temporary success sometimes followed, sooner or later severe injury was experienced and return to the night practice invariably followed.

In 1918 a situation arose in California which necessitated prolongation of the fumigation season well into the winter and an outgrowth of this in Orange County was a large amount of daylight work, in part performed in the bright sunshine at comparatively high winter temperatures. This was carried on without experiencing the severe injury which had always proved a check in former years. One operator in particular was so impressed with the possibilities of daylight work that he practically abandoned night fumigation throughout the season of 1919. The past winter, 1919–20, saw an additional number of outfits fumigating very extensively during the daytime.

A special investigation of daylight fumigation was started by the writers in 1919 with the object of ascertaining the reasons for the greater freedom from injury at the present time with liquid hydrocyanic acid than in former years under the pot and machine methods of generation, and also of determining if a system of daylight fumigation both practical and safe could be developed. Partial results of this investigation are presented herewith.

Prior to 1916 orchard fumigation was performed with a highly heated gas generated in the field. The introduction of liquid hydrocyanic acid was accompanied by a new method of field application which produced a cool gas at the lower part of the tree and resulted in very different diffusion from that of the heated field-generated gas. This was pointed out by the senior writer[1] who showed that at warm temperatures the scale-kill in the case of pot-generated gas is best toward the top of the tree whereas with liquid hydrocyanic acid it is best toward the bottom. Gas concentration is proportional to scale-kill.

[1] JOUR. ECON. ENT., V. 12, No. 1, 1919.

Injury from daylight work is confined largely to the sunward side of the tree and its intensity at different heights is governed in great degree by the concentration of the gas during the exposure. This condition frequently reflects the method of generation, in the case of pot-generated gas the greatest injury being toward the top of the tree, the part of greatest concentration, whereas trees fumigated with liquid hydrocyanic acid usually exhibit injury most severe lower down on the sunward side.

It is well known that at high temperatures hydrocyanic acid is more toxic to plants than at low temperatures. Therefore, a knowledge of heat conditions within the tent at the time of treatment is essential to a correct understanding of its bearing on plant injury. Table I shows the comparative temperatures at different parts of a tented tree in the sunshine at varying periods after covering.

TABLE I.—SHOWING THE COMPARATIVE TEMPERATURES AT DIFFERENT PARTS OF A 12-FT. ORANGE TREE AFTER COVERING WITH AN 8-OUNCE ARMY DUCK TENT ON A BRIGHT SUNSHINY DAY IN DECEMBER. RECORDS TAKEN 6 TO 10 INCHES FROM THE CLOTH

Time	Sunward side (S.)		Shade side (N.)	Outside tent
	Top 11 feet	Bottom 4 feet	Bottom 4 feet	Direct sun
11.00 a. m.	69° F.	69° F.	66° F.	69° F.
11.05 a. m.	76	72	68	69
11.10 a. m.	82	79	68	69
11.15 a. m.	87	82	70	70
11.20 a. m.	91	83	71	71
11.30 a. m.	92	83	72	71
11.40 a. m.	93	83	73	72
12.00 a. m.	95	85	74	72

An examination of this table shows that the temperature within the tent on the sunward side rises rapidly for the first 15 or 20 minutes following covering, the increase at the top of the tent after 20 minutes being 20 degrees higher than the outside air, an average that was slightly increased during the last 40 minutes of the exposure. The temperature at 4 feet on the sunward side was much lower than at the top. It is of particular interest to note that the maximum temperature increase on the shaded side of the tree at 4 feet was only 5 degrees greater than the normal increase of the air temperature outside the tent and, as compared with the maximum increase near the top, sunward side, was 21 degrees less than this extreme. Therefore, it is evident that the temperature of a tree covered in the daytime is greatly increased on the sunward side especially at the top although the shaded part shows little increase above the outside air.

Holding in mind that a strong gas is more injurious than a weak one, and also that toxicity increases with the temperature, it is readily seen that in the case of pot-generated gas where the greatest strength

is toward the top of the tent, which is also the point of the highest temperature, there is concentrated a maximum of influence for injury. Turning to the use of liquid hydrocyanic acid quite the reverse is true. The gas becomes weaker toward the top of the tent, the part of highest temperature, and the most concentrated gas is toward the bottom where the influence of the sunshine is less felt. Between these two factors, temperature and gas concentration, the latter appears to be the more dominant, for as a general rule the greatest injury to trees fumigated in the sunshine with liquid hydrocyanic acid is centered about half way up the tree on the sunward side. In all cases the injury is decidedly less than with pot-generated gas. The shaded side with its more normal temperature and without the sun-influence is seldom modified to any great degree either in point of injury or scale-kill over that normal to an equal temperature at night.

Scale-Kill in Different Parts of a Tree Fumigated in the Sunshine

The scale-kill is by no means uniform throughout a tree fumigated in the sunshine but rather irregular and reflects the effects of varying temperature and gas concentration at the different parts. This is shown in the following table which gives the results based on five trees infested with black scale which were fumigated March 3, 1920, with liquid hydrocyanic acid. The scale was in the rubber stage, approaching maturity, a condition in which they are very difficult to destroy and which require sharp influences to detect distinct differences in mortality. The insects were taken from outside branches and averaged 200 to 500 for each count.

Table II—The Scale-Kill in Different Parts of 12-Foot Trees Fumigated[1] with Liquid Hydrocyanic Acid in the Sunshine with a Full Dosage Schedule for 50 Minutes, March, 1920

Tree No.	Per cent killed		
	Sunward (S.) 3 to 6 feet	Top (N.)	Shade (N.) 2 to 4 feet
1	74	36	47
2	96	87	70
3	94	17	20
4	75	11	14
5	84	36	25
Average	84	30	27

These results show the scale-kill on the sunward side of the tree at 3 to 6 feet to be greatly superior to that on the shaded side both low down as well as at the top. In fact the mortality on the shaded part

[1] Jour. Econ. Ent., V. 12, No. 5, p. 361.

of the tree averaged less than one-third as high as that at the point of greatest mortality on the sunward side. A large number of other trees which were similarly fumigated showed decidedly increased mortality on the sunward side. The scale-kill at the top of the tree appeared to be modified somewhat by its shape. As a general rule the kill at the top was noticeably superior on the part toward the sun. The sunward part of the top, however, was decidedly inferior to that nearer the bottom on the same side. While the kill at the top, sunward side, was superior to that of all shaded parts of the tree, there appeared to be no constant superiority one way or the other between the top and bottom on the shaded side. Illustrated by an average dome-shaped orange tree 12 feet tall, the highest scale-mortality in sunshine fumigation during the winter is at the periphery of the tree in the direct path of the sun and about 3 to 6 feet above the ground. The mortality appears to decrease in all directions from this point and is lowest on the shaded north side, which is least influenced by temperature changes. The scale-kill in sunshine work at any time at best must be very irregular since it is influenced directly by temperature and this varies in different parts of the tree. Furthermore, the ratio of the temperatures at different parts of a tented tree to each other changes with the position of the sun at different hours of the day as well as its angle to the horizon at different seasons of the year.

The Influence of Tenting Material

Eight-ounce special U. S. army duck is considered the most satisfactory gas-holding cloth used in commercial fumigation, and tests by the senior writer have demonstrated its superiority to drills in night fumigation. Tents are frequently dipped in tannin to prevent mildew but it has been determined by experimental night fumigation that this in no way increases their gas-holding quality. Therefore, it was a matter of considerable surprise to ascertain superior kill in sunshine fumigation with tannin-treated drill tents than with eight-ounce army duck.

Table III—Showing Comparative Scale-Kill from Sunshine Fumigation with Liquid Hydrocyanic Acid Under Tannin-Treated 6¼-Ounce Drill and Untreated 8-Ounce Duck Tents. Immature Black Scale. Full Schedule. Exposure 50 Minutes. Outside Temperature 68°—70°, March, 1920

	No. trees	Per cent killed		
		Shade (N.) 1–3 ft.	Sun (S.) 2–6 ft.	Top
Tannin-treated drill	2	99.3	99.6	99.2
White duck	3	92.7	99.5	97.7

The above table presents the results of experimental work in which five orange trees of equal size infested with immature black scale were fumigated with liquid hydrocyanic acid according to the same dosage schedule and for the same exposure. Two trees were covered with tannin-treated (dark colored) 6½-ounce drill and three trees were covered with 8-ounce untreated duck. The results of the fumigation show that the dark-colored tents gave the best scale-kill, this superiority being most evident on the north side of the tree. This difference in mortality in favor of dark-colored tents was even more effectively brought out where the maximum scale-kill departed more widely from the point of eradication than for the above trees. For instance, one set of trees given a 30-minute exposure averaged 95 per cent scale-kill on the shaded side of the trees fumigated under dark-colored drill tents but showed only 76 per cent scale-kill at the same position on trees fumigated under untreated duck tents.

This difference in scale-kill between the dark and light tents appeared attributable to the higher temperatures within the former. This condition is shown by the following table in which is recorded the temperature at different points within a tannin-treated drill tent as well as a white army duck tent.

TABLE IV—THE COMPARATIVE TEMPERATURES AT DIFFERENT PARTS OF TWO 12-FOOT TREES, ONE COVERED WITH A 6½-OUNCE TANNIN-TREATED (DARK COLORED) TENT AND THE OTHER COVERED WITH A WHITE 8-OUNCE ARMY DUCK TENT. MAY 18, 1920, 9–10 A. M. RECORDS MADE AT 10 MINUTE INTERVALS. THERMOMETERS 6–8 INCHES FROM TENT

Time	Outside temp.		Sunward 3½ ft.			Sunward 11 ft.			Shade (N.) 3½ ft.			Middle 3 ft.		
	Sun	Shade	Dark tent	Light tent	Dif.	Dark tent	Light tent	Dif.	Dark tent	Light tent	Dif.	Dark tent	Light tent	Dif.
Start	82°	78°												
10 min.	85	79	90°	87°	3°	97°	95°	2°	84°	79°	5°	83°	79°	4°
20 min.	85	80	93	89	4	104	101	3	87	81	6	86	82	4
30 min.	87	82	95	90	5	108	104	4	89	82	7	88	82	6
40 min.	88	83	98	91	7	110	106	4	90	83	7	89	83	6
50 min.	86	85	97	91	6	110	106	4	91	84	7	90	84	6
60 min.	89	85	99	92	7	112	108	4	92	85	7	91	85	6

Not only is the temperature higher at all points within a dark colored tent, especially on the shaded side where the average difference amounts to 6 or 7 degrees, but there appears to be an influence on the gas diffusion due to the heat factor which interferes with its escape through the tenting and this influence is most apparent under the darker tent. So noticeable is this difference in gas retention between the two types of tents that it is readily detected by the smell at the end of a normal exposure. In our experimental work during the winter it was observed that one could stay beneath an 8-ounce untreated duck

tent with safety and without annoyance at the end of a 50-minute daylight exposure so little gas remained, but on the other hand this was seldom possible beneath the tannin-treated tents especially on the sunward side, because of the greater volume of residual gas. Particularly of interest is the tendency of the gas to remain strongest on the hot sunward side of the tree and to escape more freely from the cooler portions.

As a possible explanation of this situation it can be stated that the sun falling on the tent produces a very rapid rise in temperature, which is greatest immediately beneath the cloth and decreases as the distance away becomes greater. The cyanid gas is cold when entering the tent at the lower and cooler part. As it diffuses with the air and rises the mixture comes in contact with the hotter air on the sunward side but appears to be retarded in escaping from the tent on this side by the very highly heated peripheral layer of air immediately adjacent to the cloth. Dark colored tenting intensifies the temperature of this layer.

TABLE V—TEMPERATURE COMPARISON ON SUNWARD SIDE OF THE PERIPHERAL LAYER OF AIR INSIDE TWO TREES COVERED RESPECTIVELY WITH LIGHT AND DARK COLORED TENTS. RECORDS TAKEN 11 FEET ABOVE GROUND ONE HOUR AFTER COVERING

Light tent 8-oz. army duck			Dark tent 6½-oz. drill		
Temp. 6-8 in. from cloth	Temp. immediately adjacent cloth	Difference	Temp. 6-8 in. from cloth	Temp. immediately adjacent cloth	Difference
106°	118°	12°	114°	142°	28°

The dark colored tent shows the remarkable difference of 28 degrees between the temperature immediately adjacent the cloth and that distant 6 to 8 inches; the white tent only 12 degrees. Records taken simultaneously at 3½ feet on the shaded side of the tree gave temperatures of 92 and 85 degrees respectively for the dark and light tents. When these latter records are compared with those taken immediately adjacent the cloth on the sunward side there is presented the very great difference of 50 degrees between the extremes of temperature within the tannin-treated tent and 33 degrees within the white tent.

The temperature of the air on the shaded or north side of the tree covered with the white tent almost paralleled that of the outside air and in the case of the dark tent was but 6 to 7 degrees higher. Therefore, the absence of a hot layer of air on the shaded side immediately adjacent to the tent allows the gas to diffuse outward as freely over this area as at night.

Comparison of Day and Night Fumigation

The effect of the gas on the scale and the effect on the plant both demand careful attention in a comparison of daylight and night fumigation and one ordinarily acts as a balance on the other in recommending or condemning the practice. From the standpoint of scale-kill, night practice can be differentiated from sunshine practice by the comparative results at different parts of the tree, and in the accompanying table is presented such a comparison for experimental work performed against the black scale.

Table VI—Comparison of Night and Sunshine Fumigation Against Immature Black Scale, Using a full Dosage-Schedule in March, 1920. Each Set of Figures Represents the Average of Five Trees.

Time	Temperature	Exposure	Per cent killed	
			Shade (N.) 2–4 ft.	Sun (S.) 2–5 ft.
Night	46°	50 min.	93	94
Sunshine	69	50 min.	95	99
Sunshine	71	30 min.	82	98

A study of this table shows that sunshine work at a temperature of 69° was decidedly superior to the night fumigation at 46 degrees. This superiority was due unquestionably to temperature differences. Experiments performed by the writers show that in night work better scale-kill occurs at higher temperatures than at low temperatures. The results in night fumigation are quite uniform throughout the bottom of the tree whereas daylight work gives the best kill on the sunward side where the temperature influence is greatest, as previously stated. Additional experiments carried out against mature black scale showed an even greater difference in mortality between night and day work, the superiority always being most outstanding on the sunward side.

Trees with a 30-minute exposure were fumigated in the sunshine simultaneously with those given a 50-minute exposure. These results, which are presented in Table VI, are of interest in showing that on the sunward side the kill is but slightly inferior to that for a 50-minute exposure whereas on the shaded side of the tree it is decidedly inferior, at this point giving an 82 per cent scale-kill against a 95 per cent kill for a 50-minute exposure. Comparing a 30-minute sunshine exposure at 71 degrees with a 50-minute night exposure at 46 degrees, the results of the daylight work are seen to be superior on the south side of the tree but decidedly inferior on the north side. In view of the

uniformity of results throughout the bottom of a tree fumigated at night, whereas in sunshine work the poorest kill is in the more shaded part which is also usually most severely infested, the figures just presented would appear to show that a 50-minute night exposure at a cool temperature is, under some conditions, superior to a 30-minute sunshine exposure at a much higher temperature.

The greater effectiveness of daylight fumigation to that at night with the same dosage and exposure is clearly evident. The temperature averages many degrees higher during the day which correspondingly increases insect activity as well as susceptibility to the gas. This superiority is most noticeable on the sunward side of the tree. In this connection it must be noted that the severest infestations of such scales as the black and purple are on the more shaded parts of the tree where the superiority of sunshine work is least apparent. This condition is of primary importance in regulating any reduction of dosage for sunshine work, for to accomplish results with a reduced schedule equivalent to night work such reduction of dosage must be made with regard to the scale-kill on the shaded part of the tree where it is most difficult to destroy. The irregularity of scale-kill is one of the greatest drawbacks to the daylight practice.

Factors Limiting Daylight Work

Sunshine coming in contact with plants immediately after fumigation and before they have fully recovered their normal physiological activity is a factor of the greatest concern from the standpoint of injury. In fact there appears to be no other meteorological condition which so intensifies plant injury. Therefore, in conducting daylight fumigation one is constantly menaced with a factor of great danger. The effect of the sunshine is modified by its intensity (this depends mainly upon the height of the sun above the horizon and the clearness of the atmosphere), by the physiological condition of the plant, by the concentration of gas and by the length of exposure. Thus in entering the field of daylight fumigation we are entering a field of complex nature. Of these factors the strength of gas, the length of exposure and the temperature or intensity of the sunshine are entirely tangible and necessarily form the basis of daylight fumigation procedure. Any plant will withstand a certain amount of gas under the most severe conditions without injury, and within certain limitations this concentration is safely increased as the length of exposure is decreased. This very point appears to be the keynote to successful daylight fumigation. Night fumigation with dosage schedule $\frac{3}{4}$ and No. 1[1] has been followed with safety for many years with exposures

[1] Bul. 90, Bur. Ent., U. S. Dept. Agr.

ranging from 45 minutes to one hour, yet the attempt to transplant these dosages and exposures to daylight fumigation under the pot-system has invariably been disastrous.

It has been explained that the more successful use of liquid hydrocyanic acid than pot-generated gas in daylight work is possible because of differences in diffusion which, in the former case, places a weak gas at the top of the tree, the part of greatest heat. This diffusion, together with possible differences in physical properties of the gas, has appeared to render the transfer of night practice to daylight practice possible with a reasonable degree of safety during the winter months when the trees are in a dormant condition. Especially is this true for lemons to which no particular injury has occurred during the past winter's fumigation.

Throughout the summer and autumn trees are very active and the sunlight intense, both of which render fumigation at this time a very precarious practice. However, fumigation can be done even under the most severe combination of conditions provided the dosage is reduced or the exposure shortened sufficiently to offset their influence. Of course, if the reduction of dosage or exposure necessary to offset the injury factor reduces the scale-kill below commercial requirements the operation is a failure.

Injury from daylight fumigation is characterized by leaf drop, particularly on the sunward side of the tree and in severe cases by bleaching of green fruit. The fruit pit so prevalent in night fumigation is infrequent in daylight work. Ripe fruit does not appear to be affected at all and trees have been observed defoliated without the colored fruit being injured in the least. Bleached fruit, if not too severe, may later recolor and appear unblemished, but severe burns reduce the grade. It is scarcely possible to conduct sunshine fumigation without considerable leaf drop. Therefore, one of the most important considerations in attempting this practice is to determine the amount of foliage that can be dropped without injury to the tree. On this growers are at variance.

The writers have taken many records of fumigation during the active autumn period at temperatures upwards to 80° F. with exposures averaging 30–40 minutes. Dosages as high as 78 and 89 per cent schedules were used. Such practice was in general very effective against the red and black scales, but the injury to the trees was frequently very severe, and in some cases gave almost complete defoliation. The injury in the early morning and late evening was less intense than during the hottest part of the day. By sharp reduction of the dosage and exposure to offset the increased intensity of the sunshine numerous orchards were fumigated at this active period without

severe injury, and particularly was this true for lemons, which appear to be far less susceptible to sunshine fumigation than are oranges.

On the other hand parts of orchards would sometimes be greatly injured even with a dosage and exposure in no way severe to the same varieties in the adjoining orchards. Such differences in injury are attributable to varying soil conditions and the physiological condition of trees, and in this we find one of the greatest drawbacks to daylight work, for it appears to intensify injury to trees least resistant to gas to a much greater extent than does night practice.

Conclusions

The writers have carried on experimental daylight fumigation with liquid hydrocyanic acid from the middle of the active fumigation season in October throughout the winter period. As a result of this work they are convinced that, where practicable, daylight winter fumigation is preferable to night work. At this period the insects are especially difficult to kill on cool nights. Furthermore, the trees are in a dormant condition and can withstand a stronger gas even at temperatures approximating 80° F. Particular attention should be given to the exposure.

While the data accumulated during the past season shows that an experienced and careful operator with a few tents can by constant manipulation of dosage and exposure practice daylight work during the growing season, especially on lemons, with partial success, such practice in preference to night work cannot be recommended at the present time. Experience has proved that fixed dosages and exposures are the safest guides to effective fumigation and the necessary data has not yet been accumulated to establish this condition for daylight summer and autumn work. In fact there is considerable doubt if a fixed dosage-exposure combination can be developed which is practical under the extreme varieties of daylight weather during the usual fumigation season, a situation which is further emphasized by the widely differing conditions between the hot interior valleys and the cooler, more humid coastal belt.

Chairman A. L. Melander: We are now prepared to show you three reels of motion pictures illustrating "Beekeeping in the National Forests," by G. A. Coleman. The pictures were screened by the chairman.

Chairman A. L. Melander: The final part of the program will be concluded by Prof. Trevor Kincaid who will briefly discuss "The Earwig Problem About Seattle." (No report was made of this talk by the Secretary.)

CHAIRMAN A. L. MELANDER: This concludes the program. The meeting stands adjourned, it being understood that we meet next year with the Pacific Division of the American Association for the Advancement of Science, as we have done this year, the meeting scheduled to be held at San Francisco, Cal.

Meeting adjourned.

E. C. VANDYKE,
Secretary.

MEXICAN BEAN BEETLE SITUATION

By W. E. HINDS, *Auburn, Ala.*

In the October, 1920, issue of the JOURNAL, pp. 430–431, appears a brief statement regarding the discovery of *Epilachna corrupta* Muls[1] in Alabama. Scouting work continued through September and October revealed the species in all, or parts, of thirteen counties. This infested area extends in a northeasterly direction from the eastern part of Tuscaloosa County and the northern part of Bibb County to the Georgia Line at the northeastern part of DeKalb County, Alabama. The area infested covers more than 4,500 square miles.

A special effort was made to secure an emergency appropriation of $250,000 from the special session of the Alabama Legislature, which met in September, to begin a campaign for the extermination of the pest in this section. This effort failed as it required a two-thirds vote to carry at a special session. Unfortunately no federal funds are available for such work at this time. With the delay incident to securing federal action there would doubtless be time for the spread of the pest during another season, thereby making the extermination of the species doubly difficult, if not quite impossible.

Meantime field work has been under way in studying the life history and insecticidal control of the bean beetle. Control efforts have proven very ineffective with all materials tested thus far. Arsenicals act primarily as repellents and exert some benefit in this way, but may not prove effective in saving a crop from practically complete destruction. It now appears that quite new materials and probably some new machinery and new methods for their application may be needed to solve this problem of control.

Among the food plants, the common bush snap beans appear to be most severely injured, and the loss is likely to be complete henceforth except for a partial yield from the earliest planted beans. This is almost equally true as regards pole beans and shell beans. Lima beans

[1] For several reasons it seems that the common name Mexican bean beetle should be used instead of bean ladybird.

develop later and in newly infested territory especially have usually made a partial crop, but certainly less than a half crop. The new food-plant, cow peas, has been so heavily attacked in some fields as to reduce the yield of hay at least 30 per cent by weight, and the feeding value would be decreased even more than that. In some cases Calfornia black-eyed peas have been completely destroyed. Soy beans have also suffered heavily in some fields, but the infestation has not been as general on soy beans as on the other food plants. While Kudzu has not been attacked noticeably in the field, complete development of the insect has been obtained under confinement upon that plant. Fortunately no wild food plants have yet been found, and no field attack upon velvet beans, although slight feeding has occurred in confinement.

The life history in the East appears to be quite different from that recorded in the West where the insect has occurred at high altitudes and under semi-arid conditions. Here the growing season is much longer than there and the breeding of the insect apparently begins much earlier in the season and continues much later. In Alabama breeding is certainly continuous until killing frosts occur. Freshly laid eggs have been found well into November, but development is, of course, retarded and reproduction less abundant than earlier in the season. While only two generations occur in the West, it seems certain that three or four occur in Alabama, and the capacity for damage will be correspondingly increased.

The proportion of hibernating adults surviving the winter under Alabama conditions is under investigation with some 8,000 beetles in the various tests. The hardiness of the species is indicated by the fact that submergence under water for twenty-four hours did not kill any of them, although forty-eight hours was fatal to all, and also by the fact that exposure to HCN fumigation at standard strength and time for the treatment of nursery stock did not kill more than one-fourth of the adults tested.

The Alabama State Board of Horticulture has established a quarantine covering the known infested area and also an adjoining safety zone approximately twenty-five miles in width, and prohibits the movement from this area of the following materials or articles when produced within the quarantined area:

1. All possible food plants or other fresh materials most likely to aid in disseminating the pest. This list includes all fresh beans and cow peas of any kind and soy beans, but not English peas, velvet beans, or thoroughly dried and cleaned beans or peas of any kind.

2. From April 1 to November 30 each year, all forms of "greens," or fresh edible plant leaves, such as those of mustard, spinach, chard, turnips, beets, collards, cabbage, lettuce, etc.; green corn ("roasting

ears"); and between October 1 and May 31 each year, all matured corn in the shuck unless in carload lots and fumigated as may be required by the Board. There are no restrictions, however, on root crops from which the tops have been removed completely, or upon peanuts, tomatoes, canteloupes, watermelons, berries, grapes, nuts or tree fruits.

3. Hays and similar forage crops, including corn stover.

4. Nursery stock, except when such stock and packing materials have been so treated as to destroy the Mexican bean beetle in all stages or in hibernation.

Similar quarantine regulations will probably be adopted by the Federal Horticultural Board and by such states as may establish quarantines. Uniformity in the matter of requirements is highly desirable, and the Alabama quarantine embodies all of the restrictions which have been agreed upon in the several conferences held by the cotton states entomologists and agents of the Bureau of Entomology and the Federal Horticultural Board. The quarantined area is already an interstate matter, as the safety zone extends for about twenty-five miles into the northwestern corner of Georgia.

Of course quarantines can only retard the spread of the bean beetle by commercial agencies. The annual dissemination by flight is certain to continue, as has that of the Mexican cotton boll weevil. But the area to be invaded by the bean beetle will very certainly exceed by far that affected by the boll weevil. It will be more like that now infested by the Colorado potato beetle. There appears to be no natural barrier, geographical or climatic, to prevent its steady spread even to the northern and eastern limits of the United States, and possibly to any section where beans are grown abundantly. The navy bean crop of the country seems likely to suffer very seriously.

The prospect for the future is not bright. The state and federal funds available appear to be entirely inadequate for such prompt and complete study of this pest as its importance demands. Control by parasites and natural enemies is not at all probable, as the bean beetles are repellent to birds and seem to have very few enemies even in their western habitat where they have occurred for forty, or more, years. Possibly some natural enemies might be found in Mexico where the species seems to have originated, and a diligent search for them should be made in that country as soon as possible. Those who have studied the situation most closely seem agreed that the entire agricultural system of the United States, in food and forage products and in the renewal of soil fertility, has never been so seriously menaced by any native, or introduced, insect pest, as it is now by the spread of the Mexican bean beetle.

A STUDY OF THE EFFECT OF COTTON WORM ON BOLL DEVELOPMENT AND COTTON YIELD

By F. L. THOMAS, *Assistant Entomologist, Alabama Experiment Station*

During the summer and fall of 1919 the writer was engaged in carrying on cotton dusting experiments at Prattville, Ala., on the plantation of the McQueen Smith Farming Co.

While examining cotton on selected plots during the first week of August several small caterpillars of the cotton worm moth were found. In four or five days the worms were very abundant and apparently in all stages of growth on cotton which had not been poisoned. By the 11th of August the worms had begun to pupate.

The cotton on this plantation had received a heavy application of ammonia fertilizer and the unusually wet year caused the cotton to take on a rank, heavy growth usually characterized as "mostly weed" or "gone to weed."

The first generation of worms that was noticed in this locality finished their work about August 18. The cotton plants were ragged from the work of the worms, but the general opinion of tenants and owners was that more good had been done than harm. The "ragging" allowed more light to get in and would prevent many of the bolls from rotting, they said.

On the 7th, 8th, and 9th of September the second generation completely stripped the cotton in fields where the worms appeared. In this connection it is interesting to note that the moths, adults of the first generation, were attracted to the richest uninjured cotton for laying eggs of the second generation. In many fields already ragged practically no further injury occurred. The cotton on which calcium arsenate had been applied for control of the boll weevil, retained its foliage. A third generation was expected, but did not develop, although the eggs were laid. Control was due to the natural parasites which became very abundant.

With entire fields looking brown, the first impression was that the damage had been great. After examination, expression was frequently given by the above-mentioned parties and others, that the damage was more apparent than real and that it didn't hurt them.

The opportunity was at hand to get some reliable information on this point under conditions existing at this time and place.

One hundred and twenty-three stalks, newly stripped by cotton worms, were selected and tagged and found to possess 1,255 unopened bolls of all sizes. For comparison, two rows in a plot of treated cotton with foliage uninjured and in the same field were selected; these rows contained 250 stalks. All open bolls on plants and rows selected were

picked at the beginning of the test, September 11. None but perfectly formed bolls were included in the weighings, thereafter. When affected by weevils the boll was discarded. Seven pickings were made covering a period of one month. At the end of that time there were still 133 green, unopened bolls on the stripped plants and with very few exceptions all the plants in the devastated area were putting out new leaves from top to bottom. On October 15 other duties interfered and opportunity to examine these plots again did not occur until December 5. Many unopened and half-open bolls were found on plants that held their foliage until frost came and stopped development.

At the beginning of the test 100 wide open fully matured bolls from plants that did not lose their foliage weighed 21 ounces, and the same number of similar bolls from plants that had lost their foliage weighed 19 ounces. It was not expected at this early date, two days after stripping, that any difference in weight could be attributed to cotton worm work. It would seem to be a natural variation.

The following record of pickings and weights is interesting:

	9/9 Foliage Uninjured, 250 Plants				Stripped of Foliage, 123 Plants			
Date	No. of Bolls Picked	Weight Oz.	Boll Weevil	Small Dried Up	No. of Bolls Picked	Weight Oz.	Boll Weevil	Small Dried Up
9/13	63	12.5	Discarded bolls		92	17.5	Discarded bolls	
9/16	50	8.0			203	36.5		
9/19	42	8.0			71	12.5		
9/23	80	14.0			161	27.5	40	
10/1					87	12.0	40	37
10/2	76	12.0	6	25	119	18.0	52	46
10/14	108	16.5		48	156	22.0		
	419	71.0	6	73	889	146.0	132	83

Average weight of 100 bolls from the stripped plot 16.42 ounces.

Average weight of 100 bolls from plot with the foliage uninjured 16.94 ounces.

All but 16 bolls out of 1,255 can be accounted for on the 123 plants in the stripped plot.* No record was made of the entire number of bolls on the 250 plants in the plot with uninjured foliage. On both plots the opening bolls were of all sizes.

No significance is attached to a comparison of the number of bolls damaged by the boll weevil on the two plots. Accurate record was not kept in the plot with foliage uninjured. The weevil-injured bolls were left on the plants for the tenant to pick.

The dried-up bolls were all small and found on both plots, but were more readily seen on the stripped plants than on those with leaves.

* Two bolls were injured by cotton worms and discarded.

Summary and Conclusion

The loss of foliage from ravages by cotton worms does not kill the cotton plants.

Stripping by cotton worms results in the much earlier maturity of unopened bolls.

There is practically no loss in weight of bolls maturing on plants without foliage.

With a killing frost occurring normally at an average date of November 10 for this locality, after which development ceases, the following conclusion is drawn:

Under boll weevil conditions and years of abundant moisture, stripping of rank growing cotton two months before a killing frost is beneficial rather than injurious.

This conclusion is contrary to the general opinion regarding cotton worm injury and the following question is therefore raised, What relation does the date of stripping bear to the amount of injury produced?

Scientific Notes

Predaceous Grasshoppers. We have had opportunity this summer to observe the highly predaceous feeding habits of one of the cricket-like grasshoppers, *Udeopsylla nigra* Scudder (determined by Professor Caudell). They were rather abundant at lights during the summer and were observed many times to be feeding on Lachnosterna adults. The beetles were either overpowered or directed into a corner and partly devoured. They generally gnawed off the legs of the beetles, leaving only stubs beyond the coxæ. In captivity they were fed May beetles and grasshoppers, upon which they readily fed. Sometimes a long and hard battle was necessary to overcome the larger grasshoppers. The writer knows of no reference to this species in literature as a predator of May beetles. R. C. Smith.

A Blossom Destroying Beetle on the Mango and Avocado. During the past spring avocado and mango groves in certain sections of southern Florida have been visited during the blossoming period by swarms of a small Scarabaeid beetle, *Anomala undulata* Mels. The beetle is nocturnal, carrying on its devastation at night, attacking the bloom spikes, cutting them off in many instances as with a knife. During the day the beetles seek shelter a short distance beneath the soil. Several groves noticed particularly were visited by swarms of this species and before any remedial and preventive measures could be carried out, considerable damage was accomplished by this pest. The habits of the larval stage are not known.

G. F. Moznette.

A Dipterous Parasite of the Parsnip Webworm (*Depressaria heracliana* Linn.). On July 12, 1920, there were received, for identification, larvæ of the parsnip webworm in wild parsnip from K. H. Fernow at Pleasant Valley, near Hammondsport, N. Y. Two of the caterpillars had pupated and these pupæ were placed in a vial for the purpose of rearing the moths. On July 18 a Tachinid fly emerged from one of the pupæ and was identified as *Dichaetoneura leucoptera* Johnson after having been compared with material from Maine in the Cornell University collection determined

by Johnson. A couple of dozen additional pupæ of the parsnip webworm were later received from Mr. Fernow, but no more parasites were obtained. The fly has apparently not before been recorded from this host and, so far as known, no other dipterous parasites have been reared from the parsnip webworm.

Dichaetoneura leucoptera was described as a new genus and species by C. W. Johnson (Psyche 14: 9, 1907), who received it from Winchendon, Mass., and Waterville, Me., where it was bred from the pupæ of *Archips cerasivorana* Fitch. Patch (Me. Agr. Exp. Sta. Bul. 149: 265, 1907) bred this fly from *A. cerasivorana* in large numbers from various localities in Maine and also from *A. fervidana*. Herrick (Cornell Agr. Exp. Sta. Bul. 311: 291, 1912) has also reared *D. leucoptera* from *A. cerasivorana*, in New York.

Dr. Bezzi, who has compared specimens of this species with type material of the European *Phytomyptera nidiventris* Rondani, declares the two to be distinct.

M. D. Leonard,
Ithaca, N. Y.

Indiana Insects. It is the plan of the Department of Entomology of Purdue University and the Agricultural Experiment Station to build up a collection of insects which will satisfactorily represent the insects found in the Central West, east of the Mississippi, and particularly those of Indiana. Records, publications dealing with Indiana insects, and specimens themselves are solicited.

Careful records of occurrence and economic importance will be kept with a view to publishing the "Insects of Indiana" at a future date. Records should, therefore, include name, authority for determination, exact locality, date of capture, stage, host if known, collector and other pertinent data.

Your coöperation is earnestly solicited. John J. Davis,
Agricultural Experiment Station, Lafayette, Indiana.

A New Apple Pest in Pennsylvania. A new pest, *Eulia velutinana* Walk, has become serious in southern Pennsylvania. The species is well known as a general feeder and has been recorded from Maple and Balsam. Heretofore it has not been recorded from apple. It was first noticed on apple in the spring of 1918, and has since been increasing in numbers and importance. This spring it was exceedingly numerous and attracted the attention of many who previously overlooked it.

An abundance of larvæ have been reared and the adults kindly determined by Mr. August Busck. In need of a common name the writer has been calling it the two-banded leaf roller. This distinguishes it from the four-banded leaf roller, *Eulia quadrifasciana* Fernald, which is a pest in New York State.

The species passes the winter as adults which issue about the middle of May and lay their eggs in masses on the larger limbs and trunks of the apple. The larvæ are yellowish-green and three-quarters of an inch long when full grown. They transform the latter part of June and the adults issue, laying their eggs in masses of twenty to forty on the leaves. The eggs are yellowish-brown in color and very much flattened, resembling the eggs of other leaf rollers. There is no doubt that there are several generations during the summer.

Considerable injury has been noticed on drop fruit caused by this species. The cavities are usually shallow although frequently they are deep and resemble those of the green fruit worm but smaller. During the summer they continue their depredations. In the late fall the species has been observed feeding on the fruit and making large shallow cavities. It is not uncommon to find the larvæ feeding at the time the fruit are picked.

S. W. Frost.

State College Research Laboratories,
Arendtsville, Pa.

An Insect Supposed to Breed in Corn. During the past few months much interest has been shown in the European corn borer, *Pyrausta nubilalis*. Native insects affecting corn are also of interest. In view of this fact the writer wishes to call attention to an insect, which for years has been supposed to breed in corn. It is quite possible, as the writer will attempt to prove, that the describer of the insect was in error as to its host plant or he would not have given it the name of *Achatodes zeæ*.

In the latter half of May the writer collected several lepidopterous larvæ from the stems of elder. These larvæ resembled the true cornstalk borer, *Diatraea zeacollela*, so much, that the specimens were forwarded to Mr. August Busck for determination. Mr. Busck determined them as *Achatodes zeæ* stating that their host plants were strawberry and corn.

Later the writer asked Dr. F. H. Chittenden if he knew anything about the host plants of this insect. Dr. Chittenden wrote the writer a rather detailed account, which is given here verbatim: "Being interested in stalk borers that affect truck crops, I am able to give you valuable information in regard to *Achatodes zeæ* Harris.

"This is one of the cases in which Dr. Harris was wrong. This species which was described in Harris' Treatise feeds exclusively, so far as records go, in the stems of elder (*Sambucus* sp.) and any other records of its injuring corn and strawberry are, in my opinion, incorrect. The true corn and strawberry culprit is *Papaipema nitela* or *nebris;* in other words, the species mentioned by Harris in 'Insects Injurious to Vegetation,' Flint Edition, 1862, pp. 438–440, refers to both species. The moth figured on Plate 7, figure 9, is *Achatodes zeæ* and the larva figured on page 440 is *Papaipema nebris*."

Larvæ of this species were fairly common in the stems of elder at Tullulah, La., during the last of May and the first of June.

Marion R. Smith.

A Note on Migration of Larvae of the House-Fly. Along a stretch of some 150 feet of road in Wellington, Kansas, there is found a strip of grass about two feet wide along one side of which a cement sidewalk runs and along the other a cement curb raised perhaps eight inches above the macadamized road with which it is connected. The whole is gently sloping to the west.

About the 15th of May, 1917, this grass area as well as a plot of some two acres adjoining the sidewalk was covered with a thick layer of barnyard manure which had probably been stacked for some time.

A few days later, about 6.00 o'clock in the morning, in passing by this stretch of road, large numbers of the larvae of the house-fly, *Musca domestica*, were observed on the sidewalk and in the gutter adjoining the manured strip. They were only fairly numerous on the sidewalk, but in the gutter they lay in a white band extending the whole length of the manured space, perhaps eight inches wide and towards the curb several larvae deep.

This whole seething mass was working down the street towards the west and were found to be entering a sewage manhole which adjoined the west end of the manured area.

By noon this date, practically all the larvae had disappeared.

Considering that the majority of the larvae had entered the manhole, they had migrated from one to 150 feet. And they had preferred migrating this distance in search of soil in which to pupate rather than enter the soil beneath the manure.

George W. Barber,
Scientific Assistant, Bureau of Entomology, U. S. Department of Agriculture.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

DECEMBER, 1920

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. Photo-engravings may be obtained by authors at cost. The receipt of all papers will be acknowledged.—EDS.

Separates or reprints, if ordered when the manuscript is forwarded or the proof returned, will be supplied authors at the following rates:

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This is the official organ of the American Association of Economic Entomologists, an organization of 566 members, each with equal or nearly equal rights to the privileges and benefits of the organization. The volume for this year is practically filled with the Proceedings of the Annual Meeting and those of the Pacific Slope Branch and, as a consequence, there has been no space for the independently submitted papers. It is fitting that the Proceedings should be given precedence according to custom, because the doings of the annual gatherings are of general interest to the entire membership. It is highly desirable that the man unable to attend or the one with an important message should have an opportunity to present his case. The JOURNAL should cover a wider field than the publishing of the Proceedings and it is highly desirable that its pages be open to all qualified contributors. The high cost of printing and the limited funds available make it impossible to issue a larger volume and, while such conditions exist, it is suggested that those attending the meetings keep the matter in mind and by means of carefully prepared papers, abstracted if necessary, keep down the length of the articles and thus reduce the size of the Proceedings. The formal papers in the volumes for 1917–1919 inclusive have an average length of about six pages, 2,400 words. It may be necessary to keep papers pretty closely within these limits; that is, make the average of the past few years the approximate maximum of the present and thus give a more equal opportunity to our entire membership. The value of a paper should not be gauged by its length; it is the message that counts. There is no better time than the present to excel in the selection of the pertinent and thus assist in making room for the other man.

Reviews

Insect Artizans and Their Work. By EDWARD STEP. Pages 1 to 318. 54 illustrations. Dodd, Mead and Company, 1920.

We have in this little volume an interesting series of sympathetic discussions of the activities of various insects, their nature being indicated by such titles as spinners and weavers, miners, masons, carpenters and wood-workers, upholsterers, wax-workers, paper makers, tailors, etc. The author, following the lead of Fabre, has brought into a volume records of the habits of a number of the more interesting typical species, mostly European, some American and others from different parts of the world. Those with a liking for natural history and the adaptation of life to varying conditions, will find much that is suggestive and stimulating. We have in this volume, non-technical accounts, attractive to the amateur and by no means uninteresting to those who have penetrated deeper into the mysteries of nature.

Current Notes

Conducted by the Associate Editor

Mr. William Beutenmuller has changed his address to Box 258, Highwood, Bergen County, N. J.

The annual meeting of the New York State beekeepers took place at Syracuse, December 1–3.

Mr. F. G. Graham has been appointed temporary superintendent of fumigation at Windsor, Ontario.

Dr. C. C. Miller, a prominent authority on apiculture, died at his home, Marengo, Ill., September 4, 1920.

Mr. Harlan P. Worthley has been appointed investigator in entomology at the Massachusetts Agricultural College.

Mr. A. C. Mason, Bureau of Entomology, has been assigned to work on biological studies of rust mites at Orlando, Fla.

Mr. Arthur D. Borden, Bureau of Entomology, is now in charge of the laboratory at Alhambra, Calif., vice R. S. Woglum, resigned.

The *Experiment Station Record* announces the resignation of V. R. Haber, as research assistant in entomology at the Minnesota Station.

According to *Science*, Professor Harold R. Hagan has resigned as professor of zoölogy and entomology, at the Utah Agricultural College.

The North-Western Beekeepers' Association held its annual meeting at the Great Northern Hotel, Chicago, on Monday and Tuesday, December 6 and 7.

Professor W. W. Henderson, formerly entomologist at the Utah Station and College, has been appointed president of Brigham Young College, Logan, Utah.

The degree of doctor of laws has been conferred by Brown University upon Professor Vernon Kellogg of Stanford University, now secretary of the National Research Council.

Entomologists have just learned of the death of Mr. William H. Patton, of Hartford, Conn. Mr. Patton died a year or more ago. For many years he had been in the Retreat for the Insane at Hartford, and formerly published a number of articles

in the entomological journals, mostly dealing with the Hymenoptera, in which he described several new species.

Mr. Mitchell Carroll, assistant in entomology, New Jersey Agricultural Experiment Station, has resigned to accept a professorship at a college in Pennsylvania.

According to *Science*, Professor William J. Crozier of the University of Chicago has been appointed professor of zoölogy and public health at Rutgers College, New Brunswick, N. J.

Mr. Herbert J. Pack has been appointed instructor in zoölogy and assistant entomologist at the Utah College and Station, vice Charles J. Sorenson, resigned to engage in commercial work.

Mr. George S. Demuth, for several years connected with the Bureau of Entomology, Division of Apiculture, will soon relinquish government work to become editor-in-charge of *Gleanings in Bee Culture.*

According to *Experiment Station Record,* Professor C. E. Sanborn, entomologist of the Oklahoma College and Station, is to spend the coming year in California on special entomological investigations.

Mr. George B. Pearson, a graduate of the Mississippi Agricultural and Mechanical College, has been appointed field assistant in the Bureau of Entomology with headquarters at West Lafayette, Ind.

Mr. Arthur Gibson, dominion entomologist, Ottawa, Canada, spent a few days at Boston and vicinity in September, visiting the various laboratories maintained by the United States Bureau of Entomology.

Professor W. C. O'Kane has been elected president of the Faculty Science Club of the New Hampshire College. Professor O'Kane recently met with an accident in which he lost the end of one of his fingers.

According to *Science*, Professor T. D. A. Cockerell, of the University of Colorado, has been elected an honorary fellow of the American Museum of Natural History, in recognition of his distinguished services to science.

The fortieth annual convention of the Ontario Beekeepers' Association was held at the Agricultural College, Guelph, December 1–3. At this time will be formally opened the new apicultural building, which has been pronounced the finest one in North America.

Dr. Joseph L. Hancock, of Chicago, an authority on the grouse locusts (Tettiginæ) on account of increased medical responsibilities has given up his studies in the Orthoptera and his collection has been added to the Hebard collection at the Academy of Natural Sciences, Philadelphia.

Dr. T. J. Headlee spent two days in Connecticut, October 20 and 21, examining the equipment and methods of gipsy moth work. He gave a brief address before the Windham County Medical Association at Danielson, Conn., October 21, and also addressed the Connecticut Public Health Association at Hartford, Conn., November 11, both on the subject of mosquito elimination.

A hearing on extending the territory covered by the Japanese beetle quarantine was held before the Federal Horticultural Board in Washington, September 10, followed by a conference of entomologists concerning the recently discovered gipsy moth infestations in New Jersey and New York. According to the Florists' Exchange, the following entomologists were present: E. N. Corey, Maryland; L. A. Stearns, Virginia; E. C. Cotton, Ohio; C. R. Crosby, George G. Atwood, New York; T. J.

Hèadlee, John J. Davis, C. H. Hadley, H. B. Weiss, C. W. Stockwell, New Jersey; Dr. L. O. Howard, A. L. Quaintance, A. F. Burgess, C. L. Marlatt, W. R. Walton, E. R. Sasscer, E. H. Siegler, W. B. Wood, C. A. Weigel and H. W. Lamp, Bureau of Entomology, Washington, D. C.; E. D. Ball, assistant secretary of agriculture.

Larvæ of the satin moth *Stilpnotia salicis* Linn. were found in August, feeding upon poplars in New Westminster, B. C. This insect is a European species first reported on this continent from Medford, Mass., by Mr. A. F. Burgess, during the past summer. (See page 370 of this JOURNAL.)

Mr. Arthur Gibson, who for many years has been assistant entomologist in the Entomological Branch, Canadian Department of Agriculture, has been appointed dominion entomologist and head of the Entomological Branch to succeed the late Dr. C. Gordon Hewitt, who died in February, 1920.

Mr. W. E. Hinds, entomologist, Alabama Polytechnic Institute, lost his entire entomological library in the fire which destroyed the Agricultural Building October 17. He would appreciate the coöperation of fellow entomologists in replacing such bulletins and reports as may still be available for distribution.

According to the *Experiment Station Record*, a state appropriation of $5,000 has been made by the New York Legislature, at the request of fruit growers, for a special investigation by the State Station of the merits of the new dusting methods for the control of insect pests and fungous diseases as compared with spraying.

According to *Florists' Exchange*, Dr. E. D. Ball, assistant secretary of agriculture, and C. L. Marlatt, W. R. Walton, and L. H. Worthley of the Bureau of Entomology, left Washington October 2 to visit Massachusetts, New Hampshire, New York, Pennsylvania, and Ontario, to investigate damages by the European corn borer.

In New York State, a state employees' pension law has been enacted which affects all station workers. It provides for voluntary retirement at the age of 60, and compulsory retirement at 70 years. The amount of the pension is determined largely by the length of service and the salary at the time of retirement, but in no case can it exceed one-half the amount of the salary at the time of retirement.

Mr. J. L. King, entomological assistant of the Pennsylvania Bureau of Plant Industry, has been selected by Dr. A. L. Quaintance, who is in charge of the Japanese beetle investigations and control work, to study and collect parasites and predaceous enemies of the Japanese beetle in its native home. Mr. King sailed from San Francisco on October 20, and after a brief stop in Hawaii will proceed to join Mr. Claussen in Japan.

The following resignations from the Bureau of Entomology have been announced: Charles A. Bennett, Satsuma, Fla; Harold H. Link, Orlando, Fla; Ernest L. Chambers, Doylestown, Pa.; R. S. Woglum, Alhambra, Calif., to become director of entomology for the California Fruit Growers' Exchange; R. A. McKeown, Medford, Ore.; A. R. Moore, Riverton, N. J.; H. E. Thompson, Riverton, N. J.; H. E. Loomis, Macclenny, Fla.

Hessian fly "field laboratories" have been established in Ohio at Bryan, Sandusky, Columbus and Wooster by the Experiment Station, College of Agriculture and State Board of Agriculture. Entomologists of the three institutions are coöperating in a state-wide effort to minimize the damage to the wheat crop caused by this pest. C. H. Waid, of the Board of Agriculture, will have charge of the field work at Bryan; C. L. Metcalf, of the University, will be in charge at Columbus; P. R. Lowry is in charge at Sandusky, and H. A. Gossard is conducting the work at the Station. The

September *Monthly Bulletin* contains an article by T. H. Parks, entomologist of the University Extension Service, on "Wheat-Sowing Dates to Avoid Hessian Fly." Additional recommendations based on the present investigations will be widely disseminated by the county agents and press of the state.

Messrs. C. H. Curran, Vineland Station laboratory, I. J. Arnason, Lethbridge laboratory, V. C. Smith, F. P. Ide, headquarters, J. B. MacFarlane, R. S. Hawkins and Professor V. S. Pulling, spruce budworm survey, R. S. Longley, apple sucker quarantine, R. N. Bissonnette, field crop and garden insects and H. A. Robertson, Treesbank laboratory, have resigned from the Entomological Branch, Canadian Department of Agriculture.

Mr. Arthur Gibson, dominion entomologist, accompanied by Messrs. McLaine and Keenan, visited the European corn borer infestation in western New York on September 20, and were shown about by Mr. L. H. Worthley. On September 22, an important conference on the European corn borer was held at St. Thomas, Ont., at which Mr. W. R. Walton, L. H. Worthley Bureau of Entomology, and Dr. E. P. Felt, state entomologist of New York, were present.

After serving for twenty-five years as head of the Department of Horticulture and Entomology, and eleven years as head of the Department of Entomology of Purdue University and Experiment Station, Professor James Troop now relinquishes his position in the Experiment Station and will devote his time to teaching in the School of Agriculture. Professor John J. Davis, formerly with the United States Bureau of Entomology, is now head of the Department at Purdue.

According to *Science*, Professor George P. Gray, assistant professor of entomology, and chemist of the insecticide laboratory, University of California, has resigned to become chief of the division of chemistry of the newly organized California State Department of Agriculture, with headquarters at Sacramento. The work of the division of chemistry under Professor Gray includes the official analysis and testing of insecticides, fungicides, fertilizers, dairy products, and problems connected with the fruit and vegetable standardization laws.

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Important Notice

Until January 1, 1921, orders for Banks Index to the Literature of American Economic Entomology, 1905 to 1914 inclusive, will be accepted for $5.00 per copy. The Colcord Index to the Literature of American Economic Entomology, 1915 to 1919 inclusive, $5.00 per copy. For delivery in foreign countries, 50¢ extra.

Payment should accompany order.

After January 1, 1921, orders for these books will be received at the following rates:

Banks Index	$6.00 per copy
Colcord Index	$6.00 per copy

Parties desiring to secure the lower rate must order before January 1.

A. F. Burgess, *Secretary*.

Melrose Highlands, Mass.
November 24, 1920.

Mailed December 22, 1920

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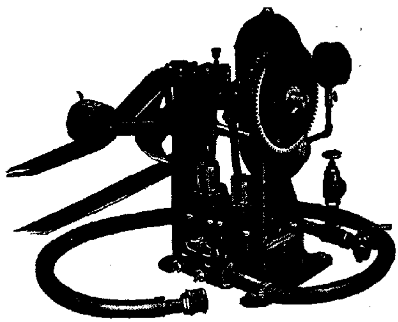

Fig. 761, For operation by gasoline engine.